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Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 25

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ARGENTINE RELATIONS WITH CANADA IN NUCLEAR FIELD REVIEWED

Buenos Aires LA NACION in Spanish 23 Dec 79 p 2

[Article by Enrique Ardissone, LA NACION correspondent: "Changes in Canada and Relations With Argentina"]

[Text] Ottawa, 22 Dec 79--Until a couple of years ago, when things began to change, Canada and institutional stability were synonymous in the eyes of the Argentines. The changes that have come about in the vast northern country, especially the most recent ones--first Trudeau's defeat and now the fall of the Clark cabinet and the call to elections on 18 February--moves us away from a mere contemplative position and imposes the necessity on us of evaluating the perspectives of a bilateral relation in which nuclear cooperation plays a very great role.

It is already known that Canadian inflexibility regarding safeguards led Argentina to award construction of the Atucha II power plant to a German firm, putting aside a proposal of the Ottawa government. Abundant and precise arguments were opportunely expounded by the head of the National Atomic Energy Commission, Rear Admiral Castro Madero, to which one must add that at the time the fragility of that government was apparent.

The Nuclear Field

It is therefore now urgent to try to discern which differences may be engendered in the field that interests us most directly, that is, the nuclear, in the case of either the reinstatement of the conservatives to power or the return of the liberals who exercised it uninterruptedly for 16 years.

Canada is characterized as a technologically advanced producer with respect to reactors, but with conditions, as was said above, in the matter of safeguards. Its position has been directed toward attaining policy agreement with other suppliers rather than seeking agreements with purchaser countries.

It is obvious that our attitude, so unequivocally disposed to the peaceful use of nuclear energy, does not present difficulties, least of all insurmountable ones, with respect to negotiations. Lamentably, the head of Foreign Relations, Flora MacDonald, intervened with intemperate opinions in the matter of human rights and even though later, on the occasion of the visit of the OAS Committee, she wanted to provide a positive aspect to her comments, the fact is that her inopportune intervention damaged the dialog.

Relations

Minister Brigadier Pastor said that Argentina is tired of friendship being declaimed at the negotiation table and forgotten in forums where it becomes a dead letter. Also there were indications that the conservative government is subjecting its cooperation programs to political ideologies.

For those and also other circumstances our country will have to again re-examine soon its position regarding whether, in the nuclear field, Canada will or will not be a future good partner. For some time Ottawa's unconsulted changes were known, with their emphasis on safeguards, which they tried to link with pre-existing contracts, but it is also undeniable that Clark tried to open the way to put aside a foreign policy of extraordinary concomitances, with dangerous incursions, in deference to a domestic reality that does not make questionable experiments possible.

The Economic Question

Canada cannot accord itself the luxury of selecting its purchasers in the face of an economic picture that includes great uncertainties, with a gross pruduct that will increase a meager .8 percent, and an approximately 8 percent unemployment index. These are questions on which a possible conservative government will have to act.

With the liberals, although their unreasonable demands did little to help in the expansion of nuclear exportations, that situation could be less complex. In the last instance, they displayed greater prudence in the conduct of their relations with other countries, and it cannot be concealed that the so-called "policy of the third choice" facilitated the beginning of new plans with nations that do not have important economic ties with Canada.

All of this helps to foster the expectation that Argentina will have to await the electoral pronouncement of 18 February.

The physiognomy of the government that emerges--more specifically, its method of operation--will have a bearing on our present decision to reject the Canadian proposal with respect to Atucha II, but also the possible renewed participation of Canada in the other three foreseen power plants, a more important package than that of the former bid at auction. It must not be forgotten that Castro Madero hinted that the next three reactors may be part of the Canadian produced CANDU system.

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SIEMENS OFFERS DETAILS ON FUTURE MIXED NUCLEAR ENTERPRISE

Buenos Aires LA PRENSA in Spanish 25 Nov 79 Sec 2 p 3

[Text] At a press conference held yesterday, shortly before departing after a 5-day stay in this capital, the chairman of the Safety Council of Siemens A.G. of Germany, Dr Peter von Siemens, announced that the plans for investment in the country over the next 5 years would involve $50 million.

He also expressed confidence that a favorable decision would be reached on the issue of safeguards between Argentina and Germany, so that the Atucha II nuclear powerplant could be built. In addition, he cited the scope of the collaboration that Siemens could offer in the event that the operation of the metropolitan underground were adjudicated to a group of interested German banks.

With Dr Von Siemens at the meeting was his son, Peter Carl von Siemens; as well as the president and executive vice-president of Siemens S.A. of Argentina, Drs Eduardo A. Roca and Walter Boos, respectively; the managing director, Ekkehard Koethe; and other officials from the company.

Remarks by Dr Von Siemens

The visitor began by reviewing the activity carried out by the business-owning group that he heads, recalling that it started its activities in 1847 and that, 20 years later, it initiated its collaboration on the development of Argentina.

He added that, in 1907, the main office decided to set up a company here in accordance with Argentine laws and standards, and that it had engaged in its activities uninterruptedly since that time, "experiencing good times and some that were difficult, during these past decades."

He noted that he was visiting Argentina after a 10-year absence, when the nation's economy was beginning to prosper. He added that, at the present time, after the difficulties well known to everyone, "I think that it is on a good path again. The country is progressing; the economy is making a transformation into a free economy. There is no unemployment, and the balances are positive. In other words, Argentina is being once again recognized in the world as a country with a future; because, added to all this, it has the fundamental bases of oil and food, among other items."

Telecommunications

He then commented that the company has maintained good relations with Argentina with regard to the development of telecommunications; adding: "I am looking forward hopefully to the new bidding to be opened next week."

Nuclear Energy

On the subject of nuclear energy, he declared that he was proud of the operation of the Atucha powerplant, and of the fact that the government has now adjudicated it Atucha II.

With regard to the safeguards, he and Dr Boos stated that they were "optimistic about the negotiations that the governments have been conducting."

As for the financing for them, Mr Koethe explained that it was divided into two basic sectors: one for supplies of the items to be imported, which have export insurance and a guarantee from the German bank, Kreditanstalt fuer Wiederaufbau [Loan Bank for Reconstruction] of Frankfurt; and, as a supplement, the financing of the other costs, including those incurred in Argentina, covered by a group of banks headed by the Westdeutsche Landesbank [West German Farmers Bank], of Duesseldorf. He then gave a reminder that the total cost of the transaction, amounting to $1.5 billion, would thereby be financed in its entirety.

Argentinatom

Dr Von Siemens was next asked about the establishment of the new mixed enterprise consisting of KWU [Kraftwerk Union], with a 25 percent share, and CNEA [National Atomic Energy Commission], with the remaining 75 percent. He explained that, although it does not yet have a name of its own, it is being called "Argentinatom," temporarily. He also said that the establishment of the new enterprise does not mean that other Argentine firms will not be participating in engineering projects. He pointed out, in addition, that the KWU investment has not been determined, although the majority of it will be in the transfer of technology, a specialty which the so-called "Argentinatom" will, in turn, be able to transfer later to any other country without any restrictions.

In response to another question, the head of Siemens A.G. said that, although no determination has yet been made as to the technology to be applied by CNEA to the next nuclear powerplants that are to be bid on, KWU is working with the pressure tube systems as applied in other powerplants which are already in operation in various countries.

Finally, on the nuclear topic, he said that there was no chance of a veto on the part of KWU regarding the decisions to be made by the enterprise which is to be established; and that, with respect to Atucha II, which was initially designed to generate 600 megawatts, at this point KWU can give assurance that it may reach 692, as occurred in the case of Atucha I, which was initially planned for 320 megawatts and which eventually generated an average of 365.

Underground

Upon being asked next about the possibility of Siemens' participating in the operation of the metropolitan underground services, the head of the German firm stated: "Absolutely not. We are not interested in running the services, but rather in contributing technology to improve them." He explained that, in Germany, the underground services are also run by the municipalities; and Dr Boos added that what has been reported is that German banks are interested in forming a consortium to take over the service, and also to improve and expand it, and that this is a group with which Siemens might collaborate.

Future Investments

Concerning the company's future plans, he said that, during the next 5 years, a contribution of capital amounting to about $50 million has been called for, which would make a total of $110 million in the same currency since 1954, when the firm began to engage in its activities in the country with an impetus.

These investments will be allocated for machinery, die-works and supplementary production buildings, as in the case of Osram (an enterprise of the Siemens group) which will open a new industrial plant next year in the locality of San Isidro, in Buenos Aires Province.

Problems in Iran

At the end of the conversation, during the discussion of the activity that Siemens is carrying out in 35 different countries, the firm's president was asked about the politicoeconomic proposals represented by the Trilateral Commission (an organization promoted by the adviser to the president of the United States, Mr Zbigniew Brzezinski); and Dr Von Siemens replied that he was not familiar with that organization.

When asked his opinion of the situation in Iran, where his company also has interests, the visitor declared that he regarded it as "critical," but that he "hopes that the tension will subside and that this country will return to normality." He concluded by saying: "No one can be excluded from interdependence in the world nowadays."

Return to Germany

Yesterday afternoon, the chairman of the Safety Council of Siemens A.G. Dr Peter von Siemens, departed for Germany, together with his son, Peter Carl von Siemens, who holds the position of general director of the American Regional Area for the company.

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IAEA HEARS SOME HOME TRUTHS

Madras THE HINDU in English 12 Dec 79 p 8

[Editorial]

[Text] The just concluded New Delhi session of the International Atomic Energy Agency could be called a success--though not quite in the sense the nuclear weapons powers and their associates, which have long dominated that organisation and bent it to their sectarian purposes, would have liked it. It was a success in the sense that the nuclear have-nots, which belong to the "Group of 77," were able, as rarely before, to focus the international community's attention on the lop-sided manner in which this specialised agency of the U.N. has become to function, deviating from its basic aim which was "to promote the widest use of atomic energy for industrial and humanitarian purposes." Encouraged probably by the fact that the session was held this time in the capital of a country which has been in the forefront of the crusade to remove the inequities and discriminatory practices that pervade peaceful nuclear activities, developing countries, one after the other, told the nuclear haves and their close supporters, as well as the IAEA's Director-General whose sympathies seemed to lean towards the nuclear "establishment," that the organisation should return to its original purpose (to help member-nations derive greater benefit from nuclear power) particularly at a time when the compulsion to shift away from traditional forms of energy like oil has become great. They pressed their view, which was that the Agency, only one of whose seven declared objects is to administer safeguards, should spend less time playing policeman on behalf of the nuclear powers which wish to perpetuate their monopoly of both military and civilian nuclear power and more time promoting the flow of technical services, materials and know-how. The developing countries were also able to explode the myth that the nuclear powers have managed to foster in recent years, namely that the IAEA's principal function is to act as a supervisor of the unequal and discriminatory Nuclear Non-proliferation Treaty; nothing could be farther from its purposes, because it was those nations which dreamed up the NPT and all the other contrivances like full-scope safeguards (aimed at keeping cheaper and more productive nuclear fuel cycles to themselves) that had established the link between the NPT and the IAEA.

The emphasis on the regulatory function of the IAEA to the virtual exclusion of its promotional aspects has nowhere been more blatant than in the manner in which the IAEA collects and distributes its resources: while all the funds for carrying out its one-sided "safeguard" activities come out of the regular IAEA budget, the bulk of the resources (ten out of 15 million dollars) needed for the technical assistance programme has been coming from voluntary contributions--and for the year 1980 these amounted to a paltry five million dollars. Evidently countries which spend trillions of dollars acquiring newer and more diabolical nuclear hardware become extremely thrift-minded when it comes to giving money which would promote peaceful nuclear endeavours. In a realistic scheme not only should funds for technical programmes come from the regular budget, but these technical programmes should not have any strings--such as discriminatory safeguards restrictions--attached to them. India and Argentina have lent force to this aspect by refusing to accept technical aid from the IAEA. There is also considerable substance in the complaint of the developing countries, especially African and Asian, that they are inadequately represented in the Board of Governors of the IAEA--at present 17 of the Board's 34 members are from among the nuclear power fraternity and their friends. This issue as well as the question of regular funds for technical assistance was in the end sidetracked by the conference. But judging by the remarks of the Director-General who has taken note of these strongly expressed dissenting views, it is clear that the nuclear-haves have not altogether succeeded in brushing them under the carpet.

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VARIOUS TYPES OF ENERGY, TOKAMAK REACTORS DISCUSSED

Various Types of Energy

Warsaw PRZEGLAD TECHNICZNY INNOWACJE in Polish No 39, 30 Sep 79 p 28

[Text] Information is presented here for the first time about projects to construct energy complexes consisting of nuclear, hydro and thermal power plants.

The meeting was held in Leningrad on 1 August and was attended from the Soviet side by members of the Presidium of the Association of the USSR Power Industry and Electrical Engineering Industry including: Nikolayevich Kovalov, chairman of the Main Directorate; Prof Nikolay Nikolayevich Tikhodeten, vice chairman; Secretary General Zhurovlov and others. And from the Polish side the meeting was attended by Dr Eng Marek Brokowski and Magister Eng Janina Sypniewska, secretaries of the Chief Technical Organization, and members of the Association of Polish Electrical Engineers from Bielska-Biala, Krakow, Torun and Warsaw.

The Association of Power Engineers has 363,000 active members grouped in 28 scientific and engineering sections that are associated with the Main Directorate in Leningrad. It copublishes seven engineering-scientific periodicals of which the oldest, ELEKTRICHESTVO, will be celebrating next year the 100th anniversary of its founding. Like other associations, it organizes national seminars, contests and exhibits and carries on day-to-day activities.

In discussing the energy situation, Prof Kovalov said that in principle thermal electric power plants are not being built in the European part of the Soviet Union. The lack of coal deposits and crude oil make it undesirable to construct such power plants in this region because costs to transport such fuel are too high. Presently, only nuclear power plants are being built here. The most northerly situated power plant now operating is on the Kolskiy Poluostrov peninsula; the most southerly nuclear plant, near Erevan, is now under construction. Between these two points about 20 more nuclear power plants will be built. At the power plant near Leningrad, which has a projected power output of 4000 MW, two 1000-MW power units are now in operation. The largest nuclear power plant, which will have a power output in the range of 8 to 10 GW, will be constructed in the region north of Kiev where favorable conditions exist for the construction of such a giant. On the strength of a CEMA decision, electricity from power plants located in the southern section of the USSR will flow to Poland and other countries via a projected 750-kV line.

The energy situation is favorable in the Soviet Union's eastern regions. There one can find inexhaustable water resources, and thus it will be a hydro-power region. In the hydroelectric power plant already built in Krasnoyar, Bratsk, one of the power units in the Sayan-Shusenskoye power plant, which in the future is supposed to generate 7 GW, is operating. Even larger hydro-power plants are being projected. This region also contains extensive coal reserves.

Four coal-powered plants, each having a projected power output of 4 GW which will provide power for the Urals and the Kazakh Republic, are under construction. Western Siberia contains even greater reserves of coal. A group of power plants having a combined power output of about 50 GW will be built there; these plants will provide power for Siberia as well as the European part of the USSR.

One of the more important concerns of Soviet power engineers is electric power transmission. About 30,000 km of 220-kV, 30,000 km of 330-kV and 2,500 km of 500- and 750-kV transmission lines are now in service in the USSR. A 750-kV line now links Leningrad and Moscow. This is the highest industrial voltage now in use, which does not mean that it is sufficient. Work is now in progress on the first 1150-kV line; perhaps it even will become operational during the current 5-year period. Gradually, after reinsulation, 500-kV two-circuit lines will be converted to 1150-kV one-circuit lines, and 750 kV will be transmitted on two-circuit 330-kV lines. It is estimated that about 10,000 km each of 750-kV and 1150-kV industrial lines will be needed in 10 to 15 years.

For long distance transmissions, constant voltage lines are also needed. In the very near future, 3,000 to 4,000 km of such lines are scheduled to be built. Constant voltage lines are also used to link power systems of different countries in order to maintain the independence of such systems. Such a link with Finland is under construction.

Underground cables are not used to transmit high voltage energy over long distances because such lines are 10 to 20 times more expensive than overhead lines. Underground cables are used in unusual cases, for example, when a line crosses a bay.

The Polish specialists were interested in the utilization of alternative energy sources. In reply to their question concerning solar energy, they were told that many experiments are being conducted. A 500-kW power plant is already in operation. A 400-MW power plant will be constructed in the current 5-year period. A scientific and engineering conference on the use of solar energy will be held in Leningrad in 1981. An institute dedicated to the exploitation of solar energy will be created and located in Central Asia. Thus, these problems will be explored further.

Concerning the use of wind power, a 4-kw power station that used wind power is now operating. In the very near future a wind-powered station having a power output of several hundred kilowatts will be built. The use of small power plants powered by the wind is imaginable in that they are connected directly to industrial lines (via transformers stations in case of high voltage lines).

Of course, scientific-engineering associations are involved with only some of the problems. Practical experience shows that cooperation among multi-subbranch associations is the most effective way of resolving problems. Such is the current trend--the creation of one association for three to four ministries. It is then easier for various specialists from different subbranches to come to an agreement. By tradition, the work of power industry associations, said Prof Kovalov, is not only to discuss organizational matters but also scientific and engineering problems, especially those that do not have explicit solutions. One of them is the construction of an integrated complex consisting of various types of power plants. At every presidium meeting, some kind of scientific-engineering problem is considered. Stormy meetings lead to a crystallization of views which are then recommended to the higher authorities.

The economics of electric energy production is an important matter which still is not being considered properly. Decreasing the use of standard fuel needed to produce 1 kWh only by 1 gram means a saving of up to 1 million tons of fuel if the USSR is taken as a whole. Work is being done to realize government programs. One of them concerns the integrated development of the Sayan-Shushenskoye hydro-power plant into a group containing a nuclear and pump-storage power plant. Presently about 10 energy programs of this type are being developed.

Development of Tokamak Reactors

Warsaw PRZEGLAD TECHNICZNY INNOWACJE in Polish No 42, 21 Oct 79 pp 34, 35

[Text] Tokamak-7, the first thermonuclear device in the world with superconductor magnetic field coils, was placed in service at the Soviet nuclear physics center of the Kurchatov Institute of Atomic Energy.

As indicated in the initial commentaries and scientific writeups in the Soviet press, the Tokamak-7 is a new-generation device. It differs from other tokamaks built in the USSR and other countries in that it includes a new thermal insulation system for the highly active plasma, which decreases electric energy consumption during operation.

In the Tokamak-7 working chamber, which has a volume of about 3 m^3, a hydrogen plasma is generated which is used in experiments related to the plasma's heating and retention properties.

Tokamak-7 was designed and built by scientists and engineers from the Kurchatov Institute and the Scientific Production Association "Kriogenmash."

Commenting on the activization of Tokamak-7, P. Negorozhniy, minister of Power Industry and Electrification of the USSR and corresponding member of the Soviet Academy of Sciences, stated: "It brings humanity one step closer to realizing the almost fantastic goal of achieving an inexhaustible supply of energy."

Why does this event generate such tremendous worldwide interest? The answer probably lies in the overall energy situation. Today there no longer is any doubt that the structure of the world's energy must change--the significance of numbers representing existing fuel resources and future energy needs is emphatic. None of the conventional energy sources--solar, floodtide, wind and the like--will ensure the on the order of 50TW of energy that will be required by the middle part of the next century, and without nuclear energy, the energy gap will not be closed.

Although the significance of the experiment at the time was thought to be otherwise, the explosion of the first hydrogen bomb demonstrated that the energy of the stars can be achieved on Earth.

Of course, this works on the imagination and stimulates the most vigorous intellects of our epoch despite the fact that it would occasion tasks of unparalleled difficulty to date even when the technical conditions for realizing a controlled thermonuclear synthesis have been fulfilled. The task is so difficult that at times the question is asked: In general is there a realistic solution to such a posed problem? What are the conditions?

First of all, the thermonuclear fuel must be heated at least to temperatures that exist within the stars. This is so because it is necessary to raise the kinetic energies of atomic nuclei to levels at which synthesis reactions occur. At such high temperatures, materials exist only in the plasma state--a quasi-neutral mixture of free electrons and positive atomic nuclei. The temperature at which generated energy exceeds energy losses is called the ignition temperature. Ignition temperatures are high--for deuterium and tritium it is 40 million °K, for pure deuterium it is 360 million °K. The internal temperature of the Sun is 20 million °K.

Retention of such a plasma, or retention for a time sufficiently long so that a large number of nuclei can interact, is another problem. The plasma density product and retention time are important here (Lawson's criterium). Gaseous deuterium at a pressure of one atm and a temperature of 350 million °K would exert a pressure of 3 million atm on the walls.

The conditions relate to realizing the so-called break-even point, initiating synthesis reaction. Extracting the energy emitted in a plasma and its practical utilization is another, new stage which occasions no less formidable technical problems.

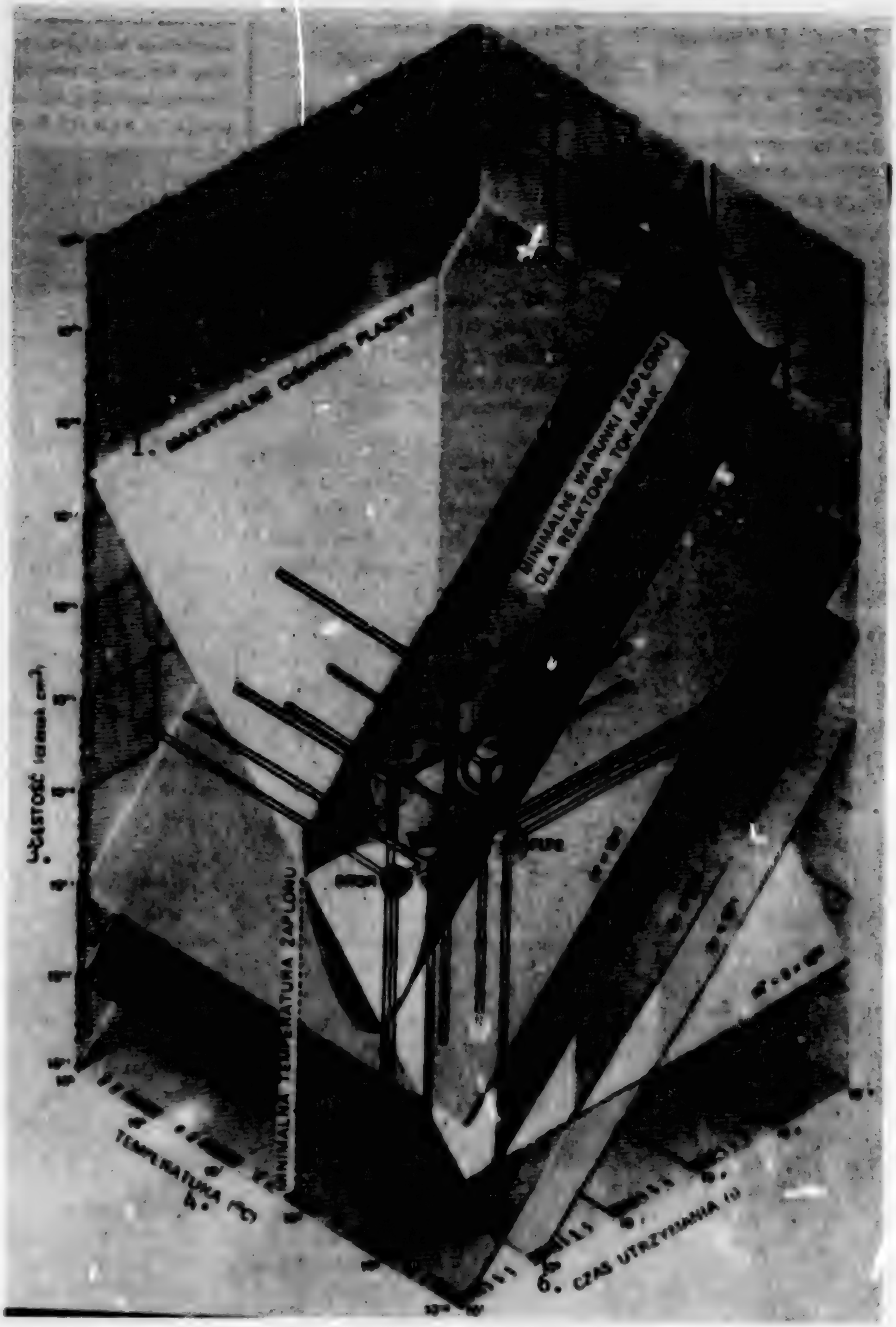
After nearly 30 years of intensive work, today it can be said that a realistic solution to the posed problem is possible. Methods to limit the plasma or a more efficient insulation method play a key role. Magnetic containment may be a practical solution: gas-kinetic pressure of plasmas is compensated by magnetic field pressure. Magnetic fields of 50 kG generate magnetic pressures on the order of 10 atm and theoretically permit the retention of plasmas at 400 million °K and 10^{15} particles/cm^3. To satisfy Lawson's criterium, it is necessary to maintain a deuterium plasma having this density for about 10 s, and a mixture of deuterium and tritium for a fraction of a second. This is becoming increasingly realistic with the aid of existing technical resources.

After many years of experimentation on various types of solutions for plasma retention and preheating, when hope was dispelled with so-called pinches (self-compressing discharges in a rarified gas) and stellarotors (maintaining a plasma stationary in a closed magnetic field configuration), an idea for a device was thought up at the Institute of Nuclear Energy in Moscow which combined both concepts. An induction current in a toroidal chamber permits a plasma to be generated, heated and limited, and the stability of the plasma permits a stronger longitudinal magnetic field than heretofore. The superposition of a longitudinal field on the field generated by its own current gives a configuration very similar to one generated with the aid of a coil in a stellarator. A closed magnetic trap emerges which at the same time safeguards plasma stability. Such a concept was presented by L. Arcymovich, director of the Institute after the death of Kurchatov. Devices based on this concept are called tokamaks.

This idea governed the development of thermonuclear research in other countries besides the Soviet Union. Tokamaks prevail in world laboratories. In 1970 there were five tokamaks in the entire world, 6 years later WORLD SURVEY listed 50.

In the 1960s several of the famous T-series takamaks were built at the Kurchatov Institute. The largest one, the T-3, has a toroidal chamber measuring 2 m in diameter and stationary fields having magnetic intensity of 25 kG. Condensors with an energy capacity of 1 MJ enabled the generation of induction current on the order of 150 kA. The parameters of the plasma generated in this equipment outperformed the parameters of plasmas generated in stellarators; for equal temperatures, plasma density was several times greater and retention time was 10 times longer. To satisfy Lawson's criterium, two orders of magnitude were lacking.

It turned out, however, that despite of the optimism of physicists, it is quite a lot. The plasma closed in the magnetic field behaved more capriciously than expected, and it was still a long way to the desired goal. The equipment which was supposed to be a prototype reactor became a basic research device instead. All in all, it enabled many subtle plasma characteristics to be identified. It was only then, on the basis of this certain foundation, that the design and construction of the next generation of thermonuclear devices was initiated at the beginning of the 197 s.



1. MAKSYMALNE CIŚNIENIE PLAZMY
MINIMALNE WARUNKI ZAPŁONU DLA REAKTORA TOKAMAK
GĘSTOŚĆ
MINIMALNA TEMPERATURA ZAPŁONU
TEMPERATURA (°C)
6. CZAS UTRZYMANIA (s)

Diagram of tokamak parameters as a function of temperature, density and retention time

[Key on next page]

Key

1. Maximum plasma pressure
2. Minimum ignition condition for a tokamak reactor
3. Density (particles/cm^3)
4. Temperature (°C)
5. Minimum ignition temperature
6. Retention time

Above all, the second generation devices are large tokamaks. Because of the results achieved with the Soviet tokamaks, many laboratories have changed their research policies. Such huge resources have been dedicated to these projects that eventual disenchantments could arrest expanded work on nuclear synthesis for many years. Fortunately the tokamaks will not disappoint anyone. The results achieved with the large tokamaks--the Soviet T-10, the American PLT and Ormak and the French TFR--corroborate theoretical expectations.

Greater densities and longer retention times have been achieved; one more step on the road to Lawson's criterium has been overcome. A record density product value and retention time were achieved in the USA with a relatively small Alcator tokamak. However, the most conspicuous result was the achievement of a temperature of 60 million °K, which exceeds the ignition temperature required for a deuterium-tritium reaction in a PLT device.

The initiation of the ToKamak-7 and its new type thermal insulation means that physicists' eyes all over the world once again turn to Moscow.

11899
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BRAZILIAN REPORTAGE ON PROSPECTIVE NUCLEAR ACCORD WITH ARGENTINA

Madero Admits Collaboration

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 12 Dec 79 p 6

[Text] Buenos Aires -- The chairman of the Argentine National Atomic Energy Commission, Vice Admiral Carlos Castro Madero, declared in New Delhi yesterday, where he is attending the assembly of the International Atomic Energy Agency (IAEA), that "a quite promising field of collaboration is opening up" between his country and Brazil. In another statement, Madero asserted that Argentina has not left the IAEA but merely rejected its technical assistance resources because "they are not useful."

At the same time, he asserted that he will be in Rio de Janeiro before President Figueiredo goes to Buenos Aires in March 1980. Madero appeared optimistic about the negotiations that Argentina has conducted with the German authorities so that they amy authorize the transfer of technology acquired from the KWU company. "I do not believe we will have any problem getting the permission of the Germans," Madero declared.

Asked about the date of the conclusion of negotiations so that the Bonn government may authorize the export of equipment for the Atucha plant, Castro Madero said that "Argentina expects to have an answer before Christmas in order to be able to reach an agreement in early January.

Argentina Ahead in Development

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Dec 79 p 12

[Article by Alberto Tamer]

[Text] The already initiated negotiations between Brazil and Argentina for the signing of an agreement on nuclear cooperation will still have to overcome reaction in Buenos Aires in order that they may not become merely a declaration of intentions like the document signed with Venezuela and other countries, such as Bolivia, Peru, Paraguay, Italy, Portugal, Switzerland and Spain. The reason being that Brazil has very little to offer Argentina, which is advanced in this field by at least 20 years, except in the industrial sector.

The NUCLEBRAS Heavy Equipment Corporation (NUCLEP) reactor plant in Itaguai is the only positive element that Brazil has in its favor because parts for the future Argentine reactors could be built there. However, the whole nuclear policy of that country since 1950 has been directed toward complete selfsufficiency, not only of the complete uranium cycle but also of its industry, which very successfully succeeded in absorbing German and Canadian technology and now is associated with the Soviets in the search for new production methods. In that regard, Argentina has achieved such a degree of development that it already designs, produces and exports research reactors for various countries, including Peru.

It is true that it does not have the capability of producing large components, which are planned to be built in Itaguai in the future. But certain sectors in Argentina view with great reservation greater dependence on Brazil. While they wish to maintain good relations with Brasilia, because they need the diplomatic support of our government in the inevitable international controversy now stirred up with implementation of the transaction for the purchase of another reactor from KWU, and what is extremely important, of a heavy water plant from the Swiss Sulzer company, the Argentines do not want to overly commit themselves with us.

With that purchase, Argentina will master the complete natural uranium cycle--for which it has opted since the beginning--because all it lacked was heavy water, today imported from Canada.

The diplomatic support of Brazil for Argentina in that controversy, reciprocating the position of that country at the time of the opposition to the agreement we signed with the FRG is of some merit.

Basically the diplomats prefer to aim for the signing of a more political agreement between the two countries, forming an association in the Southern Cone of America, which would strengthen both in future negotiations. However, that is the only type of collaboration that interests Argentina at the moment. It has uranium reserves, declared last year to be in the order of 27,000 tons with prospects of 400,000 tons, enough to take care of its program of only six nuclear power plants until the end of the century. It does not need to import technology to process it or enrich it because it opted for natural uranium reactors, for the operation of which it needs only heavy water. Its industry participated with a share of at least 50 percent in the construction of the first Argentine nuclear reactor, which is operated by its technical personnel.

It addition, Argentina already has a plant for reprocessing fuel elements irradiated in reactors, having in view the separation of plutonium using a technique it began to develop in the laboratory in 1975 and has already reached the pilot-project phase, in operation until a short time ago. Plutonium reserves exceed 450 kilos and, as Rear Admiral Madero declared, in a few years they will exceed the country's uranium reserves. Finally, Argentina has shown great negotiating capability in the last 30 years of nuclear activity, which is proved, for example, by the success of the negotiations now being held with the FRG for the purchase of the KWU reactor, and with Switzerland for the Sulzer heavy water plant. But how did Argentina arrive at this degree of development?

Policy

Before 1950, the Argentine Government had already adopted a well-defined policy in the field of nuclear energy. While in Brazil in the 1960's, we discussed at the academic level what to do, what lines to follow, initiating studies on concepts of energy using natural uranium and thorium that did not have actual application, the Argentine Government opted immediately for natural uranium, initiating the construction of Atucha-1, with a capacity of 367,000 KW, in June of 1968.

The reactor was supplied by Siemens (KWU). This plant has been in operation since 1974. That year--it is important to note the fact--Argentina began construction of the Embalse plant with a capacity of 648,000 KW, also powered by natural uranium but using the Candu process sold by Canada, which will go into operation toward the end of 1980 or in 1981. Dissatisfied with the Canadian experience, the Argentines are only now concluding negotiations with KWU for the purchase of a third plant, also of natural uranium, of 600,000 KW. This plant will go into operation probably in 1986.

Only Six Plants

The two main characteristics of the Argentine nuclear plan which account for its great success and development are the definition of a line of action and realism of the projects. It envisages the construction by the year 2000, that is, up to the end of the century, of only three more plants, which will be built as the preceding ones are completed. It is estimated that by that year there will be an installed nuclear power capacity of 4 million KW. However, the Argentine energy plan approved this year officially envisages a nuclear power capacity of 952,000 KW for 1985; 1,552,000 KW for 1990; and only 2,964,000 KW in 1995. In the meantime, although Brazil--which did not begin its line of reactor construction until 1972 opting for enriched uranium--with initiation of the Angra-1 plant project, has no technical cadres or much experience in the field, today it is carrying out a program of more than eight plants. If the timetable approved by the government is approved, in 1986 we will have an installed nuclear power capacity of 1,826,000 KW. In 1990, we would surpass Argentina, with about 3.1 million KW which would be maintained in 1995, but that figure would immediately be expanded with the entrance into operation of more plants under the agreement.

Argentina Will Not Change

Argentine technicans and government authorities reiterate that the country's policy will not change; namely, the construction of one natural uranium plant at a time, until the year 2000, and the complete mastery of the fuel cycle, which will only be achieved in the coming years with operation of the heavy water plant. In the meantime, for 30 years not only has it been preparing technicians, who today have great negotiating capability and operate their own plants, but it has also been creating nuclear technology and transferring it from abroad and giving basic preference to national industry.

That is the great difference between the nuclear policies of the two countries, which explains Argentina's advantage over Brazil. The Argentines started from the position--publicly admitted--that the nuclear plants were not principally designed to supply the domestic demand for electric power because the country's hydroelectric potential is estimated at 50 million kilowatts, of which only 4 million have been utilized. The goal was to acquire technology of all types, mastering the complete uranium cycle, and to create an industry. And to do that, the course followed was to build one plant after another, purchasing the technologies most accessible and best known at the time, training technicians and acquiring experience in order in the future to reach the point twoard which it is calmly advancing at the present time.

Another important fact was the maintenance of a strong and basic agency, the National Atomic Energy Commission with executive functions, which controls the sector and divides the implementation of the projects with private industry. That avoided the confusion that occurred in Brazil as a result of the proliferation of agencies such as the National Nuclear Energy Commission and the Brazilian Nuclear Corporation (NUCLEBRAS) (derived from Brazilian Nuclear Technology Company), with all of its innumerable subsidiaries.

Possibility of Agreement

However, despite that great lag on the part of Brazil and the fact that we adopted the system of enriched uranium technology while Argentine is developing natural uranium technology, there is still the possibility of an agreement that is not bound merely to the diplomatic and political level. Brazil will be able to supply some items necessary to the Argentine nuclear program produced in the Itaguai reactor plant. That is a small-scale prospect, however, because Argentina does not plan to build more than three reactors by the year 2000.

The negotiations between Brazil and Argentina should become intensified during January and the success of the talks will depend on the negotiating capability of the Brazilian representatives to overcome the reservation of certain sectors that exists today.

In this case, unlike the case of Itaipu-Corpus, there are better conditions for dialog. But this time, Brazil is in an inferior position.

We are the ones now who are faced with a fait accompli.

CNEA Centralizes Implementation

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Dec 79 p 15

[Text] Buenos Aires--The National Atomic Energy Commission (CNEA) has the following installations for executing its nuclear plan, which this year was raised to the level of national law: a central headquarters which houses the directors, the offices and the laboratories; the Constituyentes Atomic Center, the purpose of which is to develop nuclear reactors and fuel material and elements; the Ezeiza Atomic Center, which has a low power reactor (5 [illegible]gawatts) producer of radioisotopes, sources of radiation and application st[illegible]o, and a physics institute devoted to the training of high-level specialists.

In addition, the CNEA exploits uranium deposits and has concentration plant in Mendoza with a capacity of 60 tons annually and another with a capacity of 120 tons. Added to them is a third 60-ton plant installed in the southern part of the country, a power plant in operation in Atucha, the Embalse power plant, which is under construction and the Atucha-2 power plant in the planning stage. The construction of the heavy water plant and a plant for the production of uranium dioxide in Cordoba province have been contracted.

That considerable infrastructure is also supported by an Argentine industry that is incorporating nuclear techniques with great support for the private sector, especailly the industrial seccor.

Complete Support for Industry

The CNEA is an official organ in the nuclear sector although it is not an industrial organ, different from Brazilian organization.

The CNEA fosters the nuclear industry and sometimes, through its special studies and projects directorate, initiates industrial projects and develops them for some time until conditions exist so that that industrial seed can develop by opening up bids for the national companies that can assume the project thus initiated. An example of this is the exploitation of uranium in the Serra Pintada deposits in the Andean province of Mendoza.

This deposit was exploited by the CNEA, which developed a uranium concentration project there. Once the work was underway, the CNEA opened up bids for exploitation of the ore and the production or uranium concentrate.

The company winning the bid will be responsible for the engineering project, equipment and operation of an ore processing complex having a capacity of 700 tons of uranium oxide annually.

Other Argentine companies--Tauro, Techint, Sade, McKee and Desaci--formed the Nuclear Corporation, utilizing their previous experience in working together.

As a consortium, they worked on the maintenance and expansion of the power of Atucha-1, and the Embalse plant, the second to be built in the country; they are in charge of the assembly of the heavy components.

Another company that achieved a certain level of development in the nuclear field is Pescarmosa Metallurgical Industries, which obtained a 5 percent participation in the Atucha project as supplier of mechanical components. It increased its participation in the Embalse plant to 15 percent.

Another consortium formed by private industries is Asinel, which is devoted to electrotechnics and regulation and control systems. The CNEA has charged it with construction of the amplifier system for detectors of the flow in the core of the nuclear reactor.

The functions of that equipment are to regulate and control the flow of neutrons and for safety.

Defense of Sovereignty

The possibility of the sale of nuclear equipment produced in Brazil to Argentine is very small for several reasons. In the first place, the Argentine nuclear project has as its basis premise the achievement of "energy sovereignty," the complete control of nculear energy production, so that any future purchase that implies the continuation of technological dependence is against its objectives.

In addition, the CNEA is an institution closely linked to the navy. Its chairman, since the foundation of the organization 30 years ago has been a high-ranking navy officer. At present he is Admiral Carlos Castro Madero.

This direct relationship with the armed forces is readily visible in the table of organization. Apparently the Argentine Foreign Ministry could conclude nuclear agreements over the head of the CNEA but in practice, up to now, the CNEA has to approve each of the paragraphs.

The CNEA also maintains a clearly defined policy of support for national industry, encouraging the formation of private nuclear industry in Argentina. Thus, the import of components that can be manufactured in the country is quite doubtful.

The concrete possibilities of cooperation by Argentina with Brazil in large nuclear projects, from the Argentine point of view, would be in the development of new reactors using thorium, plutonium and other minerals, according to the chairman of the CNEA.

Argentine national industry, whihc has invested time and resources in the nuclear field is not prepared to turn over the results obtained for the benefit of other foreign companies that do not have the endorsement of German or Canadian companies.

Even in Buenos Aires, it is not believed very likely that the Brazilian nuclear industry will be able to sell large components in the Argentine market, much less whole reactors, considering the small dimensions of its nuclear program. Comtemplated up to now are two nuclear plants under construction--Embalse and Atucha II--[the latter was previously said to be in the planning stage] in addition to the heavy water plant. Up to the end of the century, only four more nuclear power plants will be built, which in principle will be granted to Canada, as the chairman of the CNEA, Admiral Castro Madro, himself, hinted.

The modest nature of the Argentine atomic program does not leave any room for the sale of large components in the Argentine market, and another factor to be considered is the fact that Argentina possesses a high degree of development, almost superior to continental experience.

Argentine-Brazilian experience, according to the opinion of the National Atomic Energy Commission, should be centered on aspects almost secondary to big industry: cooperation at the pure research level, applied research, mutual information on methodology, setting of guidelines, safety, quality and production control measures, reserving more intensive cooperation for the development of the future new generation reactors.

Probable Research Agreement

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Dec 79 p 14

[Text] Bonn -- "The agreement between Brazil and Argentina will probably be in the area of research, as already exists between Brazil and other South American countries. Collaboration in the industrial sector will be difficult because the two countries have opted for different systems. In addition, if there were a cooperation plan at any level that involved equipment supplied by KWU, we would have been informed."

That statement was made in Bonn by KWU spokesman, Joachim Hospe. On the other hand, the press aide of the International Atomic Energy Agency (IAEA), the agency charged with controlling nuclear installations worldwide, said that there is no information on the matter. However, the IAEA said it did not doubt that the two countries will submit any nuclear agreement they may conclude to the control of the agency because, although they are not signatories of the nonproliferation treaty, both showed their readiness to submit to control of their plants, which is being done without any obstacle.

The German Tactic

On the other hand, an official of the German Foreign Ministry refused to comment on the speculation that the agreement between Brazil and Argentina could represent a way of getting around international resistance to the supplying of a complete nuclear fuel cycle to Argentina.

The German press recently published accusations regarding the strategem used by the Bonn nuclear industry to gain the Canadian bid. Since the Canadian Government was only prepared to sell the reactor and the heavy water processing unit to the Argentine customers with the establishment of extra safeguards, the German bidders divided the contract with a Swiss company, relieving themselves of the accusation that they were violating international pledges and furnishing the complete fuel cycle to a country that was not a signatory of the nonproliferation agreement. To all effects, German industry would only be supplying the reactor. The Argentines would be buying the heavy water plant from third parties. Despite the maneuver, the Canadian Government reacted in a very determined manner, even threatening to cut off the supply of uranium to the European Community, according to last week's edition of the magazine DER SPIEGEL.

In this context, the Brazil-Argentine agreement could serve German interests doubly. Once signed, it would make superfluous any pressure on the German Government against supplying the fuel cycle to Argentina. In a few years, Brazil will be in possession of such a cycle, which would naturally also be passed on to the Argentines under terms of the agreement. It would be practically impossible again to put pressure on the Brazilian-German agreement after Washington failed in its first attempt. The Brazilian-Argentine agreement would then be the checkmate in the international pressure against supplying the fuel cycle to Argentina. On the other hand, if despite the agreement, the pressures should continue, German industry still has the possibility of passing part of the order to NUCLEBRAS Heavy Equipment Corporation (NUCLEP), for example, dividing responsibility once again, as it had already done before with the Swiss.

A German diplomat from the Latin America section of the Bonn Foreign Ministry, however, refused to comment on such speculations, saying only that "any comment would only serve to feed the wave of rumors circulating about international pressure." According to him, the matter of pressure on the part of Canada and the United States is an invention of the German press.

The governments of Canada and West Germany are allegedly fully in agreement with regard to the deal between KWU and the Argentine Government, and there is no disagreement between the two countries in that regard. The important thing, in the opinion of the two governments, is the furnishing of guarantees regarding the nonutilization of radioactive material for military purposes. Such a guarantee reportedly is being offered by Argentina, which has all of its atomic plants under the control of the IAEA despite the fact that it did not sign the nonproliferation treaty.

The Bomb

According to Thomas Roser, the superintendent of the Deutsches Atomforum, a German organization which aims at publicizing and informing the public about the peaceful use of nuclear energy, there is no interest in Brazil or Argentina in building an atomic bomb. Several countries in the world are in a technical position today to build their own atomic bombs, among them, Brazil and Argentina. Thomas Roser believes, however, that the bomb would not be of any use to either of the two countries, since they are not threatened by external enemies which could possibly be used as the pretext to justify such a decision.

A test of nuclear weapons would only bring international discredit to Brazil and Argentina. In the opinion of the superintendent of the Deutsches Atomforum, for that reason, the excessive requirement of guarantees regarding the non-utilization of nuclear technology for military purposes is unnecessary and only the guarantee of control by international organizations such as the IAEA is sufficient.

A Positive Fact

Thomas Roser sees cooperation between Brazil and Argentina in the nuclear energy sector "with satisfaction." In his opinion, that would be another step toward ending "the rivalries of the two largest countries in South America once and for all." He also sees a certain parallel with German-French ralations. "We have been not only rivals but real enemies. Today, however, we take pride in our friendship with the French and work together with them in various sectors, including the nuclear area." Thomas Roser believes that even if cooperation between Brazil and Argentina should aim at replacing the importation of nuclear equipment from Germany, it will be well received by German industry. After all, in his opinion, one cannot expect countries that grow rapidly to remain dependent on the importation of equipment and technology in the long term.

That viewpoint of the suprintendent of Deutsches Atomform, however, could be viewed possibly as evidence that a future Brazilian-Argentine agreement would bring German industry--to which his organization is indirectly connected through its work of clarification about the peaceful use of atomic energy--many more advantages than disadvantages.

Obstacles to Agreement

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 13 Dec 79 p 33

[Text] Rear Admiral Carlos Castro Madero, chairman of the Argentine National Atomic Energy Commission, confirmed that he will come to Brazil before President Figueiredo's trip to Buenos Aires, to negotiate the terms of the nuclear agreement he plans to sign on that occasion. The Argentine officer showed optimism regarding the possibility of reaching agreement, although he does not deny the existence of difficulties stemming from the disparity of technological development between Brazil and Argentina (we are much further behind) and the fact that we have opted for enriched uranium while Argentina decided in favor of natural uranium.

Basically, there is good will at the technical and diplomatic levels with regard to the conclusion of a nuclear cooperation agreement but nobody denies that there is reaction in the Argentine military and industrial sectors, convinced that Brazil would be the greater beneficiary because it has little to give and everything to gain. In that connection, it will first be necessary to overcome those difficulties, because Argentine industrialists and military men will not want to remain dependent on the supply of parts produced in Brazil for their nuclear program since the whole philosophy followed up to now has had the objective of complete selfsufficiency. We believe that if Brazilian and Argentine diplomats know how to act carefully and tactfully, they may, contrary to what occurred in the Itaipu-Corpus case, reach agreement more quickly, at least in principle. We cannot deny that Brazil will be the great beneficiary of this cooperation because it will be able to furnish peices or parts of equipment to the Argentine program, furthermore, it is the only way to keep the Itaguai reactor factory occupied. And precisely for that reason, our representatives must act with great care, aware of the fact that the Argentine negotiators are better prepared in this field, as was now proved with the signing of the agreement for the third nuclear unit with Germany and heavy water plant with Switzerland.

In this area, it is also necessary not to encourage excessive optimism with regard to the possibility of getting larger orders in the Argentine market. Unlike our grandiose program, Argentina has a secure and well-directed nuclear program, but small in size. The Argentine National Atomic Energy Commission plans to install only three more nuclear plants by the year 2000, one of which is practically contracted with KWU. Thus, there will not be any room for large sales transactions by Brazil because our German partners, KWU, also the partners of Argentina, will authorize to be produced in Brazil only what cannot be produced there, such is the lack of orders and the need to employ idle manpower.

So it is necessary to look upon the nuclear cooperation agreement with Argentina as a first important step because it is the first, but a difficult one because it is encountering resistance in important sectors of that country. And it is also necessary not to dream too high with regard to the possibilities of large sales. In this case, it is a partnership in which Brazil is in a weaker position as a result of the errors of the past, characterized by the lack of definition of its nuclear policy, and by even greater errors at the present time, just as it will be in the future, with the approval of an extremely ambitious program for which we do not have the techncial resources, although we plan to install a considerably greater nuclear power capacity than the experienced Argentines and in a shorter time.

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PROBLEMS, CRITICISMS REGARDING NUCLEAR ACCORD'S IMPLEMENTATION VIEWED

Rio de Janeiro JORNAL DO BRASIL in Portuguese 18 Nov 79 p 1 Special Supplement

[Article by David Simon: "Our Nuclear Agreement: A Synthesis"]

[Text] 1. A methodical, daring and unusual mechanism of cooperation between Brazil and a partner, at that time unidentified, was conceived by the CBTN (Brazilian Nuclear Technology Company) at the end of 1973. Careful and extensive support documentation was prepared under the generic title "Basic Documents--CBTN," covering the subjects which would be the object of future negotiations. Preliminary contacts, with a view only to sounding out the receptivity to our intentions, were initiated with France, the FRG and the United States, under the previous administration, but there was only one positive response: the FRG. Those who had access to the basic CBTN documentation and who participated in the negotiations which resulted in the Brasilia Protocol (September 1974) can judge what was achieved in comparison to what was sought, by both parties, as well as the motives for the concessions made.

2. The Brasilia Protocol was followed by a more in-depth period of negotiations which resulted in the signing of the Agreement, in June of 1975, incorporating some other negotiated achievements. We find in the text which was finally approved the clear intentions for the transfer of technology and independence in the nuclear fuel cycle, that is, the mining of uranium, processing, conversion, enrichment, manufacturing, and reprocessing. That initial effort, these objectives and the creation of Nuclebras, succeeding the CBTN, were in fact, positive and encouraging. Circumstances after June 1975, however, brought new facts into the nuclear question:

(I) the international repercussions to the nuclear explosion of India and the resulting pressures, at the level of new demands for safe guards;

(II) the realization of the extreme increase in the price of nuclear plants and the significant increase in Brazil's estimated hydroelectric potential;

Some of the problems which we faced in the implementation of the Agreement, indicated in this article, resulted from a reluctance to recognize these new circumstances in time. This would only add new problems, reducing the positive aspects of the Agreement, causing financial burdens which the country might not be able to bear and creating a pole of open opposition in the national energy and scientific sectors.

3. With the exception of a small number of exports--found mainly among the nucleocrats--there is almost unanimity within the community of energy scientists and technologists in regard to a list of critical considerations related to the FRC-Brazilian Nuclear Agreement. Briefly, the following points are raised by most of the critics:

(I) due to the great difference in cost between the nuclear and hydroelectric plants and since the latter are available until the turn of the century there is no urgent need, up to 1990, to implement the program for the installation of nuclear plants in accordance with the Agreement and, from a broader view, in accordance with other Nuclebras documents;

(II) strictly economic criteria make the installation of plants to reprocess irradiated nuclear fuel inadvisable;

(III) there is no consensus in the international nuclear industry regarding an adequate long-term solution for the processing, disposal and guarding of the highly radioactive wastes produced by the nuclear plants;

(IV) the institutionalized collaboration of the national scientific community--scientists and research institutions--is necessary, especially in the most relevant nuclear questions as, for example, the transfer of technology under the "know-why" concept and not only the "know-how" concept of the technicians:

(V) the collapse of the world rhythm of orders for nuclear plants, which appeared around 1975, and still continues today, is a symptom of the confidence crisis on the part of the purchasing companies;

(VI) the technology or uranium enrichment by the "jet-nozzle" process could become technically or economically unfeasible on an industrial scale, this would compromise the desired independence in the nuclear fuel cycle: one of the pillars of the Agreement;

(VII) there are indications that the provisions in the agreements with Nuclebras subsidiaries' shareholders require review;

(VIII) there is a breakdown in the schedule for the nationalization of equipment in the plants, with the virtual exclusion, through the end of this process, of the turbogenerator sector, which would continue to be imported from the FRG;

(IX) the CNEN (National Nuclear Energy Commission, the regulating and licensing agency) on one side and Nuclebras and Eletrobras (the promoting and constructing agencies, respectively) on the other frequently have conflicting responsibilities; therefore, the CNEN should answer to an authority different from that with jurisdiction over Eletrobras and Nuclebras.

4. Over the last 5 years we have had, among others, the responsibility of giving speeches to various segments of society interested in the energy problem, in general, and nuclear energy in particular: professionals from the energy sector; congressmen from the specialized committees of the Chamber of Deputies and the Senate; militarymen from the war colleges of the three branches; scientists; students in the Superior War College; and university students. We noted that the first four topics listed above awakened great interest among these people and for this reason we are going to present some considerations in regard to them.

5. In the middle of 1974, period of the first talks which would result in the Agreement, the unit investment cost for a nuclear plant was $500 per KW, by July 1976, the time of the signing of the contracts with KWU, the unit cost was estimated at $1,300 per KW. At present the estimated costs for Angra 2/3 are on the order of $2,000 per KW. It is clear that these increases include the impact of domestic and foreign inflation and, in addition, a perhaps unbearable surcharge. But we shall see.

6. Lets compare the costs of Angra 2/3 with those of an equivalent hydroelectric project which is now available on the upper Parana. This alternative hydroelectric plant would have a capacity of 3,400 KW, would cost $800 per KW and would annually generate the same amount of energy as the Angra 2/3 complex. To build the Angra 2/3 plants $5 billion will be spent, that is, $2,000 per KW x 2 x 1,250,000 KW; the equivalent hydroelectric plant would cost $2.7 billion, that is, 3,400,000 KW x $800 per KW. In addition to this in order to generate energy throughout its useful life, the Angra 2/3 plants will consume $4 billion (in fuel) more, while the fuel for the hydroelectric plant, that is, the flow of the river, would cost nothing throughout its useful life.

7. In summary, the additional amount which the country is investing by opting for Angra 2 and 3 instead of a hydroelectric equivalent, is $2.3 billion over the short run, that is, during construction, and $6.3 billion over the total period of construction and operation. Equally important is to indicate that while 50 percent of the charges for Angra 2 and 3 will be paid in German marks, the cost of the hydroelectric plant would be almost totally covered in cruzeiros. The impact of this surcharge will perhaps be an unbearable burden for a country which is experiencing serious problems of domestic inflation and an unfavorable balance in foreign trade.

8. Now lets look at the consequences of reprocessing irradiated fuel and the handling and disposal of nuclear wastes. Until a short time ago, the line between the use of nuclear energy for peaceful purposes and for military uses was very clear and generally accepted. Significant programs for the construction of nuclear plants bloomed--without restrictions of any type--in various countries which did not have nuclear weapons, such as Spain, Italy, Japan, Canada, the FRG, Switzerland, Sweden, India and Pakistan, among

others. With the explosion of a nuclear device in India in May 1974, there occurred a radical change in attitude, concept and tolerance in international political positions. A new order (more precise, disorder) of thinking arose in the international arena, especially among the so-called "nuclear states." Conferences, seminars and multi- and binational discussions proliferated. An attempt was made, without apparent success, to resolve the conflict between the commercial interests of some and the horizontal nuclear nonproliferation principles of others. In the case of our agreement, for example, Brazil and the FRG, due to the atypical international situation, were forced to accept additional safeguards by the International Atomic Energy Agency after having signed the country-to-country agreement.

9. It seems to us that the Brazilian nuclear program will inevitably be a "study case" in the psychosocial field. Local communities, regional, state and federal administrators, scientific communities, and ecological study groups are becoming aware of the risks associated with the exploitation of nuclear energy, and at the same time they keep up to date on related world events. In this case a dialog should be set up with a public sensitized to the polution of rivers and lakes, to the petroleum spots on the beaches, to the bad odor resulting from the manufacture of cellulose, ad nauseam. It is a matter of explaining to this very unreceptive population the reasonableness of solutions involving, for example, the storage of atomic wastes or the location of a reprocessing plant itself in their municipio. Competence and a great deal of work in persuasion will be necessary to discover solutions which provide for the rights of the present population and, it is good not to forget, which will take into account the rights of the next 30 or 50 generations which, though directly affected, cannot obviously influence the decisions we make today.

10. Finally, lets look at the fourth topic cited at the beginning of our article in regard to the collaboration of the national scientific community, especially on the relevant nuclear questions. It seems reasonable to us to propose for the consideration of the appropriate governmental sectors a change of existing attitudes and preconceptions. Brazilian scientists and technicians will certainly be willing to heed a government call to cooperation in the analysis of strategic and crucial national problems, such as, the reprosessing of used nuclear fuels, the storage and guarding of plutonium and the highly radioactive wastes and the most adequate mechanisms for an effective transfer of nuclear technology.

11. In conclusion, we would say that the nuclear question, due to involving political, military and scientific facets, in addition to technological aspects, is intrinsically much more complex than a typical industrial enterprise which our administrators were and are accustomed to dealing with. Thus, the nuclear question requires a balanced, harmonious and, above all, competent situation.

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COMMENT ON TRANSFER OF NUCLEAR TECHNOLOGY TO IRAQ

'For Peaceful Purposes'

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 4 Dec 79 p 31

[Text] "The interest of Iraq in nuclear energy is strictly limited to peaceful means and there is no intention on the part of the government to develop nuclear weapons," declared the Iraqi ambassador to Brazil, Zaid Haidar, in Brasilia yesterday. In his opinion, within 50 years there will be no more oil and all countries will need other sources of energy.

In Rio, the president of the Brazilian Nuclear Corporation (NUCLEBRAS), Paulo Nogueira Batista, refused to make any comment on the matter, according to a corporation spokesman. In the meantime, sector sources asserted that any nuclear agreement between Brazil and another country would have to be authorized by Germany and be signed with the participation of the International Atomic Energy Agency.

The Iraqi Government wants immediately to begin training of specialized personnel and the exploration of uranium in its territory because it understands that programming those activities requires a lot of time. "Those are the two initial fields that a nuclear agreement with Brazil would cover. Everyone knows that Brazil does not yet have nuclear technology because its program is at a very early stage. Only in 20 years will it have mastered the whole nuclear energy cycle, in the event the agreement signed with the FRG is completely implemented."

Haidar said that the negative campaign directed against a nuclear agreement between Iraq and Brazil has nothing to do with the real possibilities of cooperation which the two countries have at this moment. "What they are trying to strike at is the agreement between Brazil and the FRG. The United States and other countries interested in torpedoing German-Brazilian cooperation have not given up and are utilizing more subtle methods of pressure," added Haidar.

The Iraqi ambassador declared that his country is completely against the introduction of nuclear weapons in the Middle East, having alerted the world against that danger. "We had four wars against Israel using only conventional weapons. The suffering and destruction among the countries in the region were very great, but the threat to world peace did not reach a very high level. With the use of atomic bombs in a fifth war, there would be the risk of the destruction of the world and of humanity. We must avoid that risk at any cost," he added.

For the time being, Brazil would only be able to export uranium prospecting and mining technology, the only phase of the nuclear program already mastered technically and which is not part of the agreement with Germany. However, the technology of the other phases of the fuel cycle will not be mastered until 1986, according to official predictions.

Export of Technology Defended

Rio de Janeiro O GLOBO in Portuguese 29 Nov 79 p 28

[Text] Curitiba--Air Minister Brigadier Delio Jardim de Matos, yesterday defended the export of nuclear technology from Brazil to Iraq "if that is useful for that country."

According to the minister, the great concern of Brazil at the present time is fuel, the rationing of which is near at hand:

"We must defend our sovereignty and if it is useful for the country we must transfer nuclear technology just as other countries transferred it to us."

Twice during the interview he gave yesterday during his first official visit to Curitiba where he came to inspect the School for Air Officers and Specialists, Minister Delio Jardim defended the export of weapons. Speaking about the export effort that must be made in all sectors to improve the national economic situation, the minister recalled that in his area, in addition to the export of planes, the country is now also beginning to sell rockets abroad:

"We cannot be so puritanical to the point of not wanting to sell arms. If we do not do it, other countries will."

Extremely optimistic regarding the national political juncture, despite the economic crisis, Delio Jardim affirmed that there is no climate for regression in the program of political opening and that the armed forces are united under the guidance of President Figueiredo.

The present economic crisis, according to Delio Jardim, is different from 1964 "because it is an imported crisis and one that is being suffered by all countries."

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CSO: 5100

FIFTH DELAY OF ANGRA-1 ENTRANCE INTO OPERATION ANNOUNCED

Sao Paulo FOLHA DE SAO PAULO in Portuguese 23 Nov 79 p 6

[Text] Rio--"Difficulties inherent in the preoperation testing phase" and "delay in the assembly of some systems" will cause a "possible delay of 2 to 3 months in the entrance in operation of Angra-1, now postponed to 1981, the president of Furnas Electric Power Plants, Licinio Marcelo Seabra, announced yesterday. He said also that according to a reassessment of the costs of the enterprise which is in the concluding phase, the cost of 1 kilowatt of power from Angra-1 has risen to $2,100 and that of Angra-2 and -3, to $2,400, increasing about 30 percent. The Angra-1 plant is appraised today at $1.26 billion and the other units at $3.12 billion each.

According to Licinio Marcelo Seabra, the increased cost per kilowatt of power from Angra-1 is due to the penultimate change in the timetable, which had scheduled the entrance of the plant into operation at the end of this year, then was officially postponed to the end of 1980. Such is also the case of Angra-2 and -3, the entrance into operation of which, according to the official timetable, is set for the beginning of 1986 and mid-1987, respectively. Those dates, however, have been superseded due to the need to reinforce the piles of the Angra-2 reactor building. The financial costs represent a 40 percent share for Angra-1 and 50 percent for Angra-2 and -3. With regard to the price per kilowatt, the president of Furnas commented "that it is not out of line with that of other countries."

No Longer in 1980

Licinio Marcelo Seabra's statement, which was not a surprise inasmuch as it had been admitted unofficially by Furnas engineers, represents the fifth postponement of the commercial operation of Angra-1. "Our target was September 1980 and the contract with Westinghouse set the month of December. Charging the core with uranium had been set for February 1980, marking the end of the assembly, but the problems that have arisen will postpone that date of operation. We can still compensate for the delay in the charging tests so that the end of 1980 is still a valid target date."

No Prediction

The construction of the heading slab for the piles of the Angra-2 reactor building will also be delayed, not being completed until the end of 1980. According to Licinio Marcelo Seabra, Furnas is now awaiting the presentation of the detailed report by KWU-NUCLEBRAS Engineering Corporation (NUCLEN), which will be submitted to the National Nuclear Energy Commission (CNEN) for analysis at the end of this year. "Even if the analysis is delayed," the president of Furnas said, "we do not have to wait for submittal of the last report to begin the work of reinforcing the foundations, which can thus be initiated if we have the basic solution."

There is not yet any estimate of the cost of reinforcement but the estimate of $5 million released by Furnas "has been completely superseded," according to Licinio Marcelo Seabra. The cost of the delay caused by the reinforcement work was set by the company some months ago at $45 million.

The determination of the site of Angra-3 (Itaorninha or Ponta Grande) will have to be made by the beginning of 1980 in order that the plant may be ready in the scheduled time, the president of Furnas said. "KWU-NUCLEN is making tests in the two areas and in case there is a need to build piles, there will not be any problem because the initial difficulties of Angra-2 have already been overcome."

Budget

Of the investment budget proposed by Furnas to the Brazilian Electric Power Corporation (ELETROBRAS) for 1980, totaling 35.5 billion cruzeiros, about 15 billion cruzeiros will be earmarked for the Admiral Alvaro Alberto nuclear plant. The Itumbiara hydroelectric plant will absorb about $3 billion and the transmission project, including the Itaipu transmission lines, about 12.5 cruzeiros. In 1979 the nuclear program projects will absorb 5.5 billion cruzeiros of Furnas' 15 billion-cruzeiro investment budget.

The schedules for completion of the Itaipu direct current transmission line, set for March 1983, "are very tight." The president of Furnas reported that the contract with the Asea-Promon consortium, winner of the bidding to supply equipment, will be signed early in 1980, while the contracts with Brazilian industry, which will have a total participation of 60 to 62 percent, will be signed by the end of the month.

Furnas' foreign debt amounts to $1.2 billion, the service charges of which represents one-third of Furnas' budget this year and will represent one-sixth of the 1980 budget. According to the president of Furnas, the company will seek foreign financing for the imported part of the direct current and alternating current circuits.

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FINANCIAL RESOURCES TO SET PACE OF NUCLEAR PLANT CONSTRUCTION

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 25 Nov 79 p 19

[Text] Brasilia--For the first time, the government has admitted that the pace of installation of the nuclear plants will be conditioned on available financial resources and the needs of the energy market. That is the gist of the text of the preliminary study of the Brazilian energy model released by the Ministry of Mines and Energy. The document does not go into detail or define the financial resources available for the sector nor time frames.

Despite the fact that it covers 17 articles, the strategy on nuclear energy is quite vague. It defines what must be done but it does not explain how; and it does not even estimate the cost of the nuclear program. Considering the country's financial situation, to make nuclear timetables compatible with existing financial resources would mean, for the time being, concluding only the construction of the three Angra dos Reis plants: The first, by Westinghouse, in the final phase; the second, with work slowed down until the problem of the foundation is resolved; and the third, already contracted but with the site yet to be determined. This proposal had already been made even by former directors of the Brazilian Nuclear Corporation (NUCLEBRAS) in a deposition before the senate congressional investigating committee that is investigating the nuclear program, not to mention its critics, who never accepted the way the contracts were made with Germany.

Despite the fact that Minister Cesar Cals has already announced a postponement of the time period for the installation of the eight nuclear plants envisioned in the agreement with Germany, from 1990 to 1995, financial difficulties will not be overcome by then. Even with the extension of the timetables, the country will have to build eight nuclear plants in 15 years. That task seems extremely difficult when the time periods for the first two units of the agreement are conditioned on the availability of appropriations, as the president of Furnas Electric Power Plants, Licinio Seabra admitted this week. The Furnas budget envisaged for next year is 35.5 billion cruzeiros of which 18 billion--a little more than half--will be earmarked for the nuclear plant. With all that accumulation of investments, the company's foreign debt comes to $1.2 billion.

In addition, the electrical sector, the one with the largest foreign debt, will require large investments in the next 3 years due to the nuclear projects and the Itaipu and Tucurui hydroelectric projects, which will enter their most critical construction phase. The president of ELETROBRAS, Mauricio Schulman, has been warning that the company can no longer continue to rely on loans abroad and if electric energy rates are not increased, the sector will be in jeopardy in 1990.

Perhaps that may explain why the minister of mines and energy has not yet asked ELETROBRAS to carry out siting studies for the next nuclear plants. The energy model indicates only that the plants should preferably be in the southeastern region of the country where the depletion of the sources of hydroelectric energy will be felt most quickly.

As for conditioning the nuclear timetables on the needs of the electric energy market, the energy model under study is also quite vague. Plan 95 prepared by ELETROBRAS, laying down the guidelines for the sector, does not envisage the installation of any other nuclear plant until 1990 in addition to the Angra dos Reis plant. For 1995, ELETROBRAS considers that the system can absorb six more units even though they may not be necessary.

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NUCLEBRAS DENIES FEC, REPROCESSING PLANT DELAYS

Sao Paulo FOLHA DE SAO PAULO in Portuguese 22 Nov 79 p 7

[Text] Rio--The results of the training programs in Germany of the Brazilian technicians who are going to operate the Fuel Element Plant (FEC) and the reprocessing plant "are quite satisfactory," and the timetables for the manufacture of equipment for those units and nuclear fuel engineering projects "are up to date."

That information was provided yesterday by Brazilian Nuclear Corporation (NUCLEBRAS) sources, which stressed "the interest and enthusiasm of the Brazilians" and the "readiness and openness of the Germans, who show interest in teaching and transferring their know-how without hiding anything, without anything up their sleeves."

Not Optimism

The assessment of those sources, who deny that it is a matter of simple optimism, is that "if the rest of the program for the transfer of technology proceeds merely as well as that observed until now, all personnel who will be trained will be fully capable of operating those units."

Begun about 4 years ago, the training of Brazilian technicians has been done basically on the production line, directed toward the operation of the units that are being built in Brazil. At the present time there are about 50 technicians apprenticed in Germany, according to the sources.

The purpose of the recent visit of NUCLEBRAS industrial director, Nei Freire de Oliveira, to Germany was not to renegotiate time schedules, according to the sources, but rather is the "normal practice of the exchange of visits between partners in a commercial contract."

"The timetables for the process of transfer of the fuel cycle technology remain unchanged, and should be completed by 1985," as determined by Minister of Mines and Energy Cesar Cals.

According to the sources, the regular trips of NUCLEBRAS representatives to Germany to observe the programs underway do not forego a personal check by the NUCLEBRAS director, especially as regards manpower training.

"Some Adjustments"

In the meantime, the successive changes in the timetables for the construction of the nuclear plants permitted some "adjustments" in the contract for KWU to supply fuel elements to recharge Augra-1 and the recharges for Angra-2 and -3, according to NUCLEBRAS.

According to the contract signed with Urenco and KWU, Brazil was going to receive the fuel elements completely ready, but the delay of the entrance into operation of Angra-1 created conditions for the final machining and assembly of the fuel elements for the first recharge of Angra-1 to be done by FEC in Brazil early in 1981.

This means that Brazil will receive the uranium pellcts and the zircalloy tubes and will assemble the fuel elements. The FEC will already be in a position to manufacture the uranium pellets, according to NUCLEBRAS.

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NUCLEBRAS RETURNS IRD, IEN TO CNEN

Sao Paulo FOLHA DE SAO PAULO in Portuguese 24 Nov 79 p 6

[Text] Rio--Without any prior notice to the press, the president of the Brazilian Nuclear Corporation (NUCLEBRAS), Paulo Nogueira Batista, and the president of the National Nuclear Energy Commission (CNEN), Hervasio de Carvalho, in addition to various directors of both agencies yesterday formalized the reversion to the CNEN of the Institute of Radiation Protection and Dosimetry (IRD) and the Institute of Nuclear Engineering (IEN), which had been incorporated into NUCLEBRAS in 1975, when the latter was created.

The reorganization of those institutes had been requested by researchers and scientists, who had denounced the process of depletion undergone by the IEN through the reduction of personnel and the underutilization of research equipment. It had been approved some months ago by the presidency of the republic.

Blockade of Information

Reporters only learned about the meeting of the president of NUCLEBRAS and the CNEN through a press release because they had been put off guard by the false information from the CNEN on Thursday that Hervasio de Carvalho was "on his way to New Delhi." Hervasio de Carvalho did, in fact, leave on a trip but only at 2200 hours yesterday, to Rome.

This is not the first time that government organs connected with the nuclear energy sector have tried to throw the press off the track and set up a veritable "curtain of silence," principally because of the actions of the senate congressional investigating committee, which has been informing the public about government plans in that area.

At the present time, the National Investigation Service is carrying out investigations in electric companies on the pretext of locating the sources of leaks to the press of documents regarded as secret and affecting national security. According to observers, the investigation, in fact, is intended only to intimidate and prevent the revelation of any information about a subject that is "in the highest interest of the Brazilian people, in contrast to the wide publicity which the subject of 'nuclear energy' receives in countries such as the United States and Germany."

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FEDERAL REPUBLIC OF GERMANY

1980 BUDGET LISTS ATOMIC ENERGY OUTLAYS

Duesseldorf ATOMWIRTSCHAFT-ATOMTECHNIK in German Nov 79 p 531

[Text] In the draft Federal Budget for the 1980 budget year, total expenditures of DM 6.175 billion, or 11.2 percent more than in the current budget year, are listed in Detailed Plan 30 for the area of responsibility of the minister for research and technology (BMFT). For the individual sections of Detailed Plan 30, the following amounts are planned, among others: for the Ministry for Research and Technology itself (Section 3001), DM 45,215 million; for the Advancement of General Research (Section 3002), DM 546,247 million; for Natural Scientific Technical Research and Development (Section 3003), DM 1,332 billion; for Information Technologies (Section 3004), DM 578,500 million; for Energy Research and Technology (Section 3005), DM 2,253 billion; and for Space and Oceanic Research and Transportation Systems (Section 3006), DM 1,391 billion. Of the total expenditures under Detailed Plan 30, DM 46,647 million are personal expenditures, DM 25,640 million are ordinary administrative expenditures, DM 3,994 billion are allocations and subsidies (not including capital investments) and DM 2,110 billion are expenditures for capital investments.

In Section 3001 (all the following amounts are given in millions of DM), 2,300 are listed for INFCE [International Conference for Fuel Cycle Evaluation]; in Section 3002, 3,700 are listed for the Advancement of Research Planning, 10,500 for the Advancement of the Transferring of Technology and 340,034 for the Max-Planck-Gesellschaft; in Section 3003, there are 163,924 for the European Organization for Nuclear Research, 22,601 for the Max von Laue-Paul Langevin Institute, 84,800 for the advancement of selected focal points in natural-scientific basic research, 127,744 for the German Electron-Synchrotron, 62,361 for the GSI [Society for Heavy Ion Research], Darmstadt, 58,421 for the Hahn-Meitner Institut and 92,111 for the Gesellschaft fuer Strahlen- und Umwelt-forschung [Society for Radiation and Environmental Research]; in Section 3005, 14,000 are listed for maintaining production capacity for the manufacturing of combustion elements for prototype reactors, 120,000 for research in the field of reactor safety and general safety technology in nuclear research and nuclear technology, 16,202 for the International Atomic Energy Organization, 14,100 for Eurochemie, 383,000 for the advancement of reactor development, 604,300 for the advancement of nonnuclear energy research and technology, 7,160 for procuring uranium, 107,000 for the enrichment of uranium, 124,500 for combustion element development and disposal 366,418 for the Karlsruhe nuclear research center, 80,266 for Karlsruhe nuclear research center research installations, 317,063 for the Juelich nuclear research installation, 59,548 for the Max Planck Institute for Plasma Physics and 69,991 for the GKSS [Society for Utilization of Nuclear Energy in Shipbuilding and Shipping] research center in Geesthacht.

In addition to the amounts for nuclear energy contained in the budget for the Ministry for Research and Technology, DM 112.5 million for reactor safety and protection against radiation are listed in the 1980 budget of the Ministry of the Interior and DM 27.0 million for work on final storage of radioactive wastes of the Physikalisch-Technische Bundesanstalt (PTB) and DM 15.0 million for uranium prospecting (estimated, since finances are flexible) are listed in the budget of the Ministry for Economics. Total government expenditures for nuclear research in 1980 will amount to DM 2.08 billion, with 43.7 percent of the financing going for project advancement. With DM 1.14 billion, most of the expenditures will be going into the area in which the nuclear research centers fall. Government expenditures (including those by provincial governments) for nuclear research and technology are increased in the estimate by 8.1 percent by comparison with the preceding year, and those of the national government alone by 12.5 percent.

The table contains important detailed amounts in comparison with the budgeted amount for 1979 and the actual expenditures for 1978.

(Also compare ATOMWIRTSCHAFT-ATOMTECHNIK, Nov 78, p 537).

Important Detailed Expenditures in Millions of DM*
for the Advancement of the Respective Areas

		1980 (Estimate)	1979 (Estimate)	1978 (Estimate)
Advancement of the Respective Areas		383.00	352.00	261.45
	Total Costs			
THTR-300	1,750.00			
HTR, further development	600.00			
HTR, intermediate layer	85.00			
KNK-II	180.20			
SNR-300	3,300.00			
SNR, further development	407.60			
SNR, safety rough draft	27.00			
Expert opinion on reactor development	7.00			
Of this total amount, the association will produce,	6,356.80			
in 1980:	383.00			
Reactor safety and general nuclear safety technology		120.00	114.50	96.74
Uranium procurement		7.16	23.10	26.99
Uranium enrichment, research and development		40.00	48.00	58.81
Uranium enrichment, capital investments		67.00	48.00	44.62

Advancement of the Respective Areas (Cont'd)	1980 (Estimate)	1979 (Estimate)	1978 (Estimate)
Combustion element development, disposal, research and development	37.50	33.00	28.33
Combustion element development, disposal, capital investments	73.00	40.00	47.30
Basic research in nuclear physics, research projects	55.70	46.10	40.23
Basic research in nuclear physics, capital investments	29.10	25.00	19.22
Nonnuclear energy research	604.30	533.00	346.95
Operating expenses component, Kernforschungszentrum [Nuclear Research Center] Karlsruhe GmbH (KfK)	240.59	221.17	205.20
Operating expenses component, Kernforschungszentrum Karlsruhe GmbH--experimental installations (KfK-V)	77.06	74.04	71.86
Operating expenses component, Kernforschungsanlage [Nuclear Research Installation] Juelich GmbH (KFA)	254.87	235.69	215.05
Operating expenses component, Max-Planck-Institut fuer Plasmaphysik, Garching (PP)	41.00	39.99	36.41
Operating expenses component, GKSS Geesthacht GmbH	44.65	42.80	40.34
Operating Expenses component, Deutsches Elektronen-Synchrotron, Hamburg (DESY)	71.44	64.73	50.21
Operating expenses component, GSI, Darmstadt	41.84	40.43	35.68
Operating expenses component, Hahn-Meitner Institut fuer Kernforschung Berlin Gmbh (HMI)	41.94	39.39	30.42
Operating expenses component, Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich (GSF)	69.99	66.19	61.46
Capital investments, Kernforschungszentrum Karlsruhe GmbH (KfK)	95.82	94.31	70.27
Capital investments, Kernforschungszentrum Karlsruhe GmbH--experimental installations (KfK-V)	3.20	4.50	6.71
Capital investments, Kernforschungsanlage Juelich GmbH (KFA)	59.48	56.79	45.45
Capital investments, Max-Planck-Institute fuer Plasmaphysik, Garching (PP)	18.54	17.18	14.95
Capital investments, GKSS Geesthacht GmbH	25.33	17.66	11.95
Capital investments, Deutsches Elektronen-Synchrotron, Hamburg (DESY)	56.29	52.61	68.53
Capital investments, GSI, Darmstadt, (GSI)	20.51	12.57	11.62
Capital investments, Hahn-Meitner-Institut fuer Kernforschung Berlin GmbH (HMI)	16.47	15.75	18.29
Capital investments, Gesellschaft fuer Strahlen- und Umweltforschung MbH, Munich (GSF)	22.[illegible]	19.67	14.05
Contribution, Institut Max von Laue-Paul Langevin, Grenoble (ILL)	22.60	15.50	14.07

Advancement of the Respective Areas (Cont'd)	1980 (Estimate)	1979 (Estimate)	1978 (Estimate)
Contribution, European Organization for Nuclear Research, Geneva (CERN)	163.92	160.60	162.46
Contribution, Internationale Atomenergie-Organisation, Vienna (IAEO)	16.20	14.29	13.06
Contribution, Europaeische Gessellschaft fuer die chemische Aufarbeitung bestrahlter Kernbrenn-stoffe, Mol Eurochemic)	14.10	10.27	9.02
Advancement of the Nuclear Energy-Citizen Dialogue	10.00	4.70	4.47
Exchange of scientists with foreign countries	7.30	7.05	6.70
Research planning	3.70	3.10	2.24
Transfer of technology	10.50	3.90	3.25
Scientific cooperation with foreign research institutions	8.00	7.50	6.39

Duesseldorf, November 1979

9258
CSO: 5100

PARLIAMENT BACKS CABINET IN DEFENSE OF NUCLEAR POWER

Helsinki HELSINGIN SANOMAT in Finnish 9 Nov 79 p 13

[Article: "Diet Voted for Energy Policy, Conservative Party Supported Nuclear Power"]

[Text] Among the opposition parties only the Conservative Party supported the future use of nuclear power in a vote taken on nuclear power in the Diet. The full Diet faction of the Conservative Party supported the Finance Committee's positive stand on the future use of nuclear power even though Conservative Toivo Makynen had proposed that the problems connected with nuclear waste be resolved before any decisions are made on the construction of new nuclear power plants.

However, the Speaker's council of the Diet considered that Makynen's proposal did not differ so much from the position attached to the Finance Committee's consideration that it could have been placed against Makynen's proposal in a vote. Instead, the Diet voted for the committee's position as an alternative to the Christian League's Affer Stenback's proposal.

In Stenback's opinion the use of nuclear power should be given up in the development of Finland's energy economy. In a vote the Diet believed by a strength of 137 representatives that nuclear power must also be taken into consideration in compiling predictions for Finland's energy program.

The opinion of the Finance Committee, which won in the Diet, also contained a reservation according to which problems concerning the treatment and final storage of nuclear fuel must be resolved in a safe, permanent and purposeful manner.

Center Party Split Its Ranks

In the vote only six Center Party representatives as well as nearly the whole Swedish faction left the ruling party front. The Center Party's Mauri Pekkarinen, Lauri Palmunen, Hennele Pokka, Markku Kuppinen, Marjatta Vaananen, and Kauko Juhantalo abstained since in their opinion a Diet position on nuclear power should be made on the basis of a fundamental discussion.

In addition to these Center Party members, Swedish Party Member Gunnar Haggblom also abstained.

The Center Party members did not make one speech on the issue on Wednesday in the discussion preceding the vote. The faction considered it sufficient that it had participated in the preparations of this issue in the Finance Committee. This, however, did not please representatives belonging to the younger wing of the faction.

The Diet voted on a couple dozen proposals concerning the report by government auditors. The nuclear power stand was only a part of the extensive report connected with the management of state funds by the Finance Committee.

The Diet rejected the proposal of the Rural Party as being out of order.

Pekka Vennamo's (Finnish Rural Party) proposal of nonconfidence in the government's nuclear energy policy was also defeated. The whole Conservative Party faction abstained. A proposal of nonconfidence in Labor Minister Arvo Aalto was also defeated by a vote of 10-120.

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CSO: 5100

REVIEW OF NUCLEAR POWERPLANT CONSTRUCTION PROGRAM

Medium, Long Range Goals

Rome IL TEMPO in Italian 23 Oct 79 p 14

[Article by Giuseppe D'Avanzo: "France Has Overcome Fear With Nuclear Powerplants"]

[Text] Paris, October--Of the 260 billion kilowatt-hours that will be France's electricity requirements in 1980, the major part, in other words about 120 billion kilowatt-hours, will be produced with imported fuels, 30 billion with fuels of French origin, 60 billion with water reserves and 50 billion will come from nuclear powerplants. While, owing to an increase in industrial production, electricity requirements will increase, amounting to 355 billion kilowatt-hours in 1985, the amount of electrical power produced with imported fuels (predominantly oil) will decrease already in 1981 until it is reduced to about 65 billion kilowatt-hours (compared with the 120 in 1980) within 6 years. The amount of electricity produced by hydroelectric powerplants and with French fuel will remain unchanged, while the electricity supplied by nuclear powerplants, still in 1985, will amount to 200 billion kilowatt-hours, equal to 56 percent of the total consumption of electricity. With regard to the rest, 19 percent will be obtained from hydroelectric sources, 8 percent from domestic fuels and only 17 percent from imported fuels.

The already planned subsequent development of the French nuclear powerplant program will make it possible, also subsequently, for 80 percent of France's electricity requirements to be met from the nuclear source.

Therefore, the percentage of France's dependence for power, which was 79 percent in 1973 (Italy, 83.4 percent) and 77 percent in 1977 (Italy, 83 percent), will be stabilized at that percentage, while, if there had been no nuclear powerplant program, it would have reached 100 percent much before 1985 and the planned increase in France's productivity would have become impossible. This is the situation toward which Italy is moving rapidly with a continuation of our inertia in activating new, appropriate sources of energy. Therefore, for the French, this winter will be the last or next to last season in which they will have to undergo the inconvenience of blackouts and of power restrictions. After this, they will be able to devote themselves to the industrial growth of their own country without heavy sacrifices and without upsetting the balance of payments and with constantly more favorable prospects of obtaining, under increasingly more advantageous conditions, the amount of oil needed and irreplaceable from crude oil producing countries in exchange for sophisticated technological products.

That will continue until progress in technological applications make it possible to achieve power resources completely replacing crude oil under economically competitive conditions. This prospect is becoming constantly less remote and at any rate is subject to sizable electric power resources.

This is a summary of all that we were able to see from the large establishments of Chalon sur Saone to the Phenix breeder reactor nuclear powerplant at Marcoule (which has made it possible to start constructing the Superphenix powerplant, and of all that we were told in Paris by the heads of the Atomic Energy Commission, French Electric Company (the French national electric power company) and FRAMATOME [Franco-American Atomic Construction Company], the industrial company with publicly subscribed shares holding exclusive rights for construction of the typically nuclear part of French uranium powerplants. The instrument by means of which France is beginning to solve its own energy problem in the medium term (1985) is the program, in process of implementation, for the construction within the next 6 years of 31 large nuclear powerplants (to be added to the five with a modern design already in operation and to the others with a lower degree of performance). For the long term (1990 and beyond), a program is being drawn up for 14 more high-power plutonium breeder nuclear powerplants the first of which (Superphenix) is under construction.

The factors that have made it possible to use this instrument effectively for achieving the above-mentioned important results may be specified as follows: 1) an appropriate, realistic technical-political point of view, 2) effective, widespread information and 3) the PWR [Pressurized Water Reactor]. Three closely interdependent factors. Before dwelling on the first and third factors, it is perhaps advisable to talk about the second one, information, an extremely important factor in a country like France where the protestors against nuclear energy have even organized themselves into a political party -- the ecologists party -- which won close to 5 percent of the votes in the last election.

Hug, EDF [French Electric Company] manager for equipment (that is to say plants) states: "I absolutely do not believe that the nuclear protest is financed by interests connected with oil, The fact is that people always react against what is new, sometimes for the better and sometimes for the worse. It should not be forgotten that, in England, when the first automobiles began to run, a man on foot, waving a flag, had to go ahead of them. When the first trains appeared, there were some who said, and believed, that railroads were imported from hell to the world. How many objections were raised by superhighways? The point is that public opinion must be informed in extremely clear and exhaustive terms on the need for these projects. It is necessary to answer democratically every question raised by the people with regard to projects as vast as a nuclear powerplant construction program.

"We realize that this is not easy, especially when faced with a great increase in contrary opinions based on sensationalistic interpretations of incomplete technical data. But, as has been and is being done in France, an endeavor is being made precisely in this direction to demonstrate to public opinion that nuclear energy is indispensable and offers smaller risks than many recently developed industrial activities. And there is an intention," Hug went on to say, "not to carry the discussion to infinity in satisfying the curiosity of public opinion, from the government down to the lowest levels."

Thus, a recent survey has shown that, in opposition to the ecologists, 57 percent of the French people are definitely in favor of nuclear energy.

In all this, differently from all that has been done in Italy where there are very many energy plans and where, for illogical reasons, the need for nuclear powerplants is affirmed and, at the same time, utilization of solar radiation is extolled to the point of making it appear to be a replacement for nuclear energy, the French program is being laid down extremely clearly. Hug pointed out: "Saving and nuclear energy are the two terms on which France's entire energy policy is based. Differently from Germany, which still has much coal and lignite, France has almost depleted those resources, while the contribution of natural gas and solar energy, concretely, is entirely marginal. Therefore, if we do not want to erode our balance of payments by paying for crude oil at increasing prices, if we want to continue our social and economic growth and if we want to limit our dependence abroad for energy, only two courses remain: saving and nuclear energy."

This kind of talk sounds ominous for a country like Italy that is worse off with regard to natural resources than France but that still wastes time on abstract discussions on the safety of nuclear plowerplants and on the possibilities of solving the nation's energy problems with the rays of a sun that is covered over with thick layers of clouds for so many months a year in a large part of our territory.

Comparison With Italian Program

Rome IL TEMPO in Italian 31 Oct 79 p 16

[Article by Giuseppe D'Avanzo: "One Single Reactor Type in French Nuclear Program"]

[Excerpt] The French Government did not hesitate to renounce slow, uncertain development of a French system and chose the American PWR, the one most widely used in the world, thus obtaining the necessary concentration of resources. Thirty-five years of "nuclear vicissitudes" in France.

Paris, October--At this point, during a laborious process that went on for almost 7 years, French government authorities and technocrats had the courage to make realistic, rational choices that Italy had specified but subsequently did not know how to implement.

1. The development of gas and graphite reactors was abandoned and the technological experience acquired was channeled toward the production of a line of fast breeder plutonium reactors (Phenix and Superphenix), the first of which went into operation in 1974.

2. An analysis, inspired solely by a search for the optimum in safety and reliability, directed toward selection among foreign nuclear reactors the ones to be produced under license in France, to be adopted by EDF then to be exported. At first, this analysis was concluded with the choice of the American BWR [Boiling Water Reactor] (General Electric) and PWR (Westinghouse) and then with concentration on the PWR.

3. A radical reorganization of the industrial system connected with nuclear facilities directed toward compensating companies that had been involved in the BWR line but especially with a view to ensuring actual capability for the country, by means of unification of resources, to implement nuclear powerplant programs and to guarantee strong export prospects.

These three basic decisions enabled EDF, a few months after the Yom Kippur War, to order an initial group of nuclear powerplants, precisely 12 900-megawatt (MW) and two 1,000-MW plants (merely to have an idea, the only Italian modern design powerplant, the one at Caorso, produces 840 megawatts), and to secure options for 10 more plants. In France, this year, the first powerplants -- Bugey 4 and Bugey 5, each with 900 megawatts -- ordered during the oil crisis in autumn 1973, went into operation or are about to go on line. In 1980, the French will be able to have electricity generated by seven more nuclear powerplants (900 and 920 megawatts). In 1981, eight more will be added; in 1982, four; in 1983, five more (including the first two 1285-MW powerplants); in 1984, four more and two in 1985. Altogether, 31 powerplants have been ordered since the Yom Kippur War. They are being added to the ones previously built or ordered (seven gas and graphite powerplants, one with heavy water and five of the PWR line ordered between 1970 and 1971).

In our preceding article, we pointed out how there are three factors -- 1) an appropriate, realistic technical-political point of view, 2) effective, wide-spread information, 3) the PWR -- that enabled France to implement the massive nuclear powerplant program by means of which French electric power production will be only 17 percent dependent on imports in 1985. In discussing the first of these three factors (we spoke of the second one in the preceding article and will treat the third one later), certain marginal but substantially critical features cannot be overlooked.

The abandonment of the gas and graphite French designed line around 1967 and the placing in operation of the uranium enrichment establishment for military purposes at Pierrelatte enabled France to differentiate clearly between that part of uranium (and of plutonium) intended for weapons from that part for peaceful purposes. This made it possible for France to supply itself with considerable amounts of slightly enriched uranium sold by the United States. To increase France's own reserves of slightly enriched uranium (indispensable for operating PWR and BWR powerplants), the Paris authorities intensifed uranium mining on French territory, improved agreements with Canada, Niger, Gabon and other African countries for supplies of uranium and, a very important fact, they took the initiative to construct the largest plant in the western world at Tricastin for uranium enrichment (EURODIF), which will go in operation in a few years and in which Italy has a sizable participation (25 percent) through ENI [National Hydrocarbons Agency] and CNEN [National Nuclear Energy Commission].

This rapid look at 35 years of French nuclear policy cannot be separated from comparisons with Italy where, when the line on which to specify the nuclear powerplant program had not yet been defined (the Westinghouse PWR was chosen only in 1975), three powerplants with three different lines were already in operation: BWR at Garigliano, PWR at Trino Vercellese and gas-graphite at Latina. Aside from other remarks, it must be stated immediately how, with the exception of the Britsh gas-graphite reactor, neither the experience acquired in construction and operation, nor the obvious reflection that diversification is incompatible with a technical and financial effort like the achievement of a nuclear powerplant program, nor the example of all that was being done abroad succeeded in preventing out-and-out codification of a triplication of reactor lines in the National Energy Plan (PEN) that became law in 1978. In fact, the PEN provides that future Italian nuclear powerplants are to be of three different lines: the BWR (General Electric), the PWR (Westinghouse) and the Canadian Candu, this last-mentioned one with the pretext of having a certain amount of plutonium in due time. Three lines -- while the French, as has been said, have only one (the PWR) -- to which the two research projects, under slow development by the CNEN, are going to be added and will be used, actually, with an extreme timelag with regard to the original programs: the Cirene reactor, a natural uranium prototype, and the PEC [Fuel Element Testing] reactor for studying breeder reactor fuel elements.

Aside from the painful realization that our National Energy Plan, regardless of how good or bad it may be, is still completely unimplemented, in comparison with all that is being done in France it is impossible not to draw attention, in that same Italian plan, to an indefinable dispersion of resources. In view of the state of our country, this was precisely what should have been avoided. In other words, it seems that in the Italian plan there was no desire to give up something and that everything was thrown in it, with a limited view of the problems and without a sound strategic framework.

On the other hand, after 1967, the French, who became aware of the long, uncertain path to follow to achieve competitive production for their gas and graphite reactor line, did not hesitate to adopt the best model available on the foreign market. They concentrated every construction resource on carrying out the program for powerplants equipped with the PWR reactor. They had in mind the country's real interests and the objective of enabling France to maintain and increase its own role in the context of the industrialized nations.

Chalon Nuclear Manufacturing Plant

Rome IL TEMPO in Italian 6 Nov 79 p 12

[Article by Giuseppe D'Avanzo: "A Nuclear Program With Guaranteed Effectiveness"]

[Text] Chalon sur Saome, November--The FRAMATOME establishment at Chalon is something quite extraordinary in Western Europe. Perhaps it is truly unique. To find something similar to the sheds spread over an area of 30,000 square meters, it is necessary to go to the aeronautical establishments on the west coast of the United States or to some Japanese shipyards where ships are built on a production-line basis with a modular system.

On the other hand, the production-line assembly of large components -- vessel, heat exchangers and pressurizers -- for the typically nuclear system of French nuclear powerplants is performed in the Chalon plant. It should be recalled that the construction program in progress provides for over 31 plants (this is the number of powerplants ordered after the Yom Kippur War) by 1985. In that year, owing to this huge construction effort, France's electricity requirements can be met by resorting to only 17 percent of fuel imported from abroad.

The various components to be put together converge at the Chalon establishment from various other plants but especially from the plants of the nearby Le Creusot complex, which include the production of special steel, foundries, large presses (almost all built in Italy), forging and an initial finishing of products, large-sized metal parts weighing tens of tons. These components are transported by special highway carriers to the Chalon establishment where -- as we have already stated -- they are assembled and subsequently finished and inspected with various systems (chemical, ultrasound and X-rays). Of the 1,000 persons working in the Chalon plant, the largest in the Western world for nuclear components, 15 percent, a percentage not exceeded in any other production sector, are in fact assigned to quality control. Once assemblage has been completed, the large assemblies are loaded from one end of the establishment directly on river carriers that transport them down the Saone, across the Rhone and often the open sea and other rivers, to the places where the powerplants are being built.

With an exterior appearance designed especially not to disturb the outside setting, the Chalon establishment and FRAMATOME, which owns it, are an expression of the indispensable enterprise spirit inspiring the French nuclear program and that made it possible to get it underway. The whole thing got its start a little over 20 years ago when the Schneider family, owner at that time of the Le Creusot machine and steelmaking complex decided, together with other French private industries, to establish the Franco-American Atomic Company (FRAMATOME) with the American Westinghouse Company with a 45 percent participation. That came about on the basis of several factors, the first of which was the intention of the Belgian Electrical Agency to have a 50-percent participation (the remaining 50 percent was supposed to be by EDF, the French national electricity agency) in the construction and operation of a nuclear powerplant, prototype of the Italian Trino Vercellese powerplant) to be built in Ardennes, close to the French-Belgian border. In accordance with a condition made by the Belgians, this plant was to have been of the PWR-Westinghouse line, because the BR3 reactor, at Mol, from which the Belgians had acquired their first experience in the production of electricity from a nuclear source, belonged to that line.

Moreover, French private industrialists realized, considerably before the government authorities, at the end of the 1950's, that the gas-graphite nuclear reactor line under development in France could not make out in plants with a technically satisfactory power. Moreover, in the United States, Westinghouse was building reactors for nuclear submarines for the United States Navy and for the (still operating) Shipping Port powerplant. In addition, the Atomic Energy Commission had supported the development of the first two nuclear powerplants for industrial purposes, entrusting the Yankee Rowe powerplant to Westinghouse itself and the Dresden plant to General Electric, with PWR and BWR reactors, respectively.

Babcock & Wilcox was already present in the emerging American nuclear market and Combustion Engineering was about to enter it (both operating with the PWR line), but the main competition was shaping up between Westinghouse and General Electric, two giants that had already become rivals at the beginning of the century in the competition between direct current, supported by Guido Pantaleon of Westinghouse, and alternating current, sponsored by Thomas Edison of General Electric. Like the Belgians, the French industrialists also believed, and all that happened was to prove that they were right, that the PWR reactor (Westinghouse) was to be preferred from every point of view.

This gave rise to FRAMATOME, which built the French-Belgian powerplant at Chooz, ordered in 1960 and placed in operation 7 years later. Owing to the decrease in the price of crude oil at the beginning of the 1960's and owing to the Gaullist policy with regard to nuclear armament (because of which the United States could not sell to France slightly enriched uranium, the fuel for PWR and BWR powerplants), 8 years had to pass before the French market began to open up to FRAMATOME. That happened when the French Government decided to shelve development of French-designed gas-graphite reactors and to set up an initial program for nuclear powerplants with American reactors, built in France under license, using slightly enriched uranium both of the PWR-Westinghouse and of the BWR-General Electric line.

The so-called diversification period was to last until 6 August 1975, with alternating vicissitudes. In February 1974, EDF assigned to CGE-ALSTHOM [General Electric Company-Alsatian Machinebuilding Company-French Thomson-Houston] an order for two 1,000-MW BWR plants to be installed at Saint Laurent des Eaux. It took out options for six more plants. A month later, on its part, FRAMATOME (for the PWR) received a contract for 12 900-MW PWR powerplants and options for four more. At this point, complications set in for CGE-ALSTHOM, which delayed the report on the safety of the BWR reactors, and then requested a revision of the prices of the contracts signed the year before. Then it revealed that it was in difficulty owing to a lack of appropriate production plants.

In this state of affairs, the FRAMATOME shareholders at that time (51 percent Le Creusot-Loire group, the new name of the old Schneider company; 45 percent Westinghouse; 4 percent other French private industries) realized that it was necessary to take a risk and they decided to invest 500 million francs to build the large Chalon establishment, which was supposed to become, as it did become later, the conclusive link in the FRAMATOME production system. Once that decision had been adopted toward the end of 1974, by the middle of the following year the work at Chalon was so far advanced that the forecast according to which it would be possible, already in June 1976, to begin mass production (as actually happened) was confirmed.

Natually, this affected considerably the 8 August 1975 decision by the French Government, which, in view of the above-mentioned facts concerning CGE-ALSTHOM-PWR [*sic*] - General Electric, decreed the end of diversification of reactor lines. It canceled the contracts with CGE-ALSTHOM for BWR-General Electric reactors. It decreed that France should have nuclear powerplants exclusively of the PWR-Westinghouse line (in anticipation -- in a few decades -- of the development of the plutonium breeder reactors of the Phenix type). It transferred to FRAMATOME the contracts previously made with CGE-ALSTHOM, to which, however, it assigned a kind of exclusiveness for the turboalternator sets of the nuclear powerplants. In addition, the establishment of a company specializing in the exportation of nuclear powerlants and modification of the share package of FRAMATOME were ordered. The Atomic Energy Commission acquired 30 percent of the shares of FRAMATOME by deducting them from the 45 percent held by Westinghouse.

Together with the abandonment of the development of the French gas-graphite line, the concentration of resources on nuclear research for developing Phenix-type plutonium breeder powerplants and the adoption of a single reactor line (PWR-Westinghouse) for industrial production powerplants, the industrial reorganization that we have just discussed is included in that clearsighted, effective techical and political point of view that is carrying France at a rapid pace to a drastic reduction of its own dependence on foreign countries for energy.

It should be pointed out that FRAMATOME is not what is called, in Italy, a "monostructure." Actually, it is a supplier, although a large one, of EDF, the French ENEL, a supplier closely supervised within by the Atomic Energy Commission and incorporated in a program for the construction of powerplants that views the EDF itself as the unquestioned and unquestionable "architect-engineer" and, therefore, implementer of the program itself. Once that has been made plain, it is impossible not to point out how, in Italy, the PEN (which became law in 1971 after 4 years of inconclusive discussions and which has been a dead letter ever since) is limited to vague announcements far from laying down the premises for effective, concrete achievements.

Phenix Breeder Reactor Details

Rome IL TEMPO in Italian 8 Nov 79 p 14

[Article by Giuseppe D'Avanzo: "The Solution to Europe's Energy Problems Is Called Phenix"]

> [Text] It is the very modern nuclear powerplant producing more fuel than it consumes. A plant with high technology solutions in complete safety. Transformation of uranium into plutonium.

Orange, November--One of the leading French nuclear complexes, including the very modern Marcoule pilot breeder powerplant, is located a little less than 20 kilometers from Orange, full of history and flourishing with tourist activity. This complex does not affect in any way the life either of the small town or of the neighboring villages in the Rhone Valley or on the adjacent hills that seem to be dozing within the old walls and with the neat, narrow lanes of medieval times.

In order to ascertain the road, in Orange, to reach Marcoule, we were compelled to ask at the police station. If you do not want to go down toward Avignon and enter the superhighway, the way to reach the Phenix powerplant directly in this complex is a complicated succession of small country roads, sometimes still gravel. But we arrived finally and, as far as we were concerned, the first impression, from the outside, is disappointing. The Phenix complex, pointed to by some as a regrettable source of huge, unavoidable ecological disasters and worse, and presented by others as the cradle of energy for the future of Western Europe, is a silent complex, seemingly dozing like the neighboring villages, somewhat smaller in size than a nuclear powerplant of the light water and enriched uranium type currently in industrial use. Between the Marcoule hill and the Rhone, it is lashed by the icy mistral that makes the water of the river curl up.

Several dozen automobiles were in the parking lot. The entrance formalities are minimum and a tour is arranged for visitors. In half an hour, the tour makes it possible to see all that there is to see, illustrated with commentaries recorded on cassettes in various languages and played through loudspeakers. The safety measures to which it is necessary to submit only to visit the area immediately adjacent to the shielded container in which the fission process goes on are identical with the measures in effect in the traditional nuclear plants. A smock and overshoes are put on and are inspected on departure solely with the small device for measuring radioactivity to ascertain whether there is a trace of contamination. Why then is this Phenix so important?

There are various reasons and, to begin, they stem primarily from the fact that world supllies of uranium are limited and that in nuclear powerplants now approved and in industrial use operating with enriched uranium a very small part of this is consumed, while considerable amounts both of plutonium and spent uranium are received from the combustion residue by means of appropiate reprocessing. The plutonium lends itself for use in nuclear fission like enriched uranium and can be used in conventional reactors. But its best utilization is in breeder plants like Phenix, called fast neutron reactors or simply breeders.

For these plants, the fuel charge, more properly called fissionable material, consists of a mixture of plutonium and enriched uranium (in the case of Phenix, enriched uranium is involved, but less expensive natural uranium is also compatible). It is surrounded by an equal amount, the so-called fertile charge, of spent uranium coming from the fuel residue of reactors of the current thermal type (PWR or BWR), or from the wastes of uranium enrichment plants. During the fission process in the breeder, this fertile charge not only functions as a neutron shield but it also is transformed into plutonium utilizable subsequently as a fissile fuel jointly with the uranium contained, together with plutonium, in the fissile charge strictly speaking of the breeder reactor.

Thus the breeder reactor, in addition to electricity like a normal nuclear powerplant, also produces more fissile material, utilizable again for operating nuclear reactors, than it consumes. In the course of around 40 years of operation, Phenix, which belongs to the last development phase of breeder reactors, will produce double the fissile material used to operate it.

In a world constantly more thirsty for energy and with the primary sources of energy -- from crude oil to uranium -- rapidly being depleted, the future of countries wishing or having to continue their development lies considerably in the use of this type of reactor. Used solely in thermal nuclear powerplants in industrial operation at present, uranium is utilized at a rate of around 30 percent. On the other hand, with the use of plutonium (which is not found in nature and is obtained only from processing uranium) through the breeder reactor cycle, over 80 percent of uranium energy is utilized. If France's entire electricity requirements were met with the electricity produced by breeder nuclear powerplants, France would have secured an amount of fissile material equivalent to the energy contained in an amount of crude oil many times greater than the oil resources of Saudi Arabia.

The French arrived at Phenix, an achievement of the Atomic Energy Commission and EDF (the French ENEL), thanks to the experience acquired starting in the mid-1960's with the Masurca, Harmonie and Rapsodie research reactors. The next step after Phenix will be the Superphenix, in an advanced state of construction at Creys-Malville, near Lyons, with the participation of Italy (ENEL) and of the Federal Republic of Germany. It is scheduled to go in operation in 1984 with a power of 1,200 megawatts electric and it will provide, in about 30 years, an amount of fissile material double the amount consumed.

The long development required for perfecting breeders is caused by various reasons not the last of which is the availability of plutonium for the initial fissile charge, but also by the difficult technology that these plants require. The element functioning as a moderator in the fission process is liquid sodium. In addition to melting at around 98 degrees centigrade and with a boiling point of 883 degrees, sodium reacts violently in contact with water and with steam and absorbs large amounts of radiation.

This gave rise to enormous technical and economic problems in the development of Phenix, which has no less than three circuits for transferring heat from the core, where the nuclear eaction takes place, to the turbines driving the electric generators. After the first circuit passes sodium through the core, it conveys it to a heat exchanger placed within the antiradiation sheath itself. In this exchanger, the heat is transferred to a second sodium circuit conveying the sodium out of the sheath to a second exchanger. There the heat is in turn transferred to a third water circuit and finally reaches the turbines with an insignificant level of radioactivity. The development of all that, however, required the solution of huge problems of mechanics, thermodynamics and chemistry applied to steelmaking with a constant concern for safety to be ensured also for maintenance and research operations, and for reliability. After 6 years of operation of Phenix, these problems are solved.

The Marcoule breeder is quite a bit more compact than the nuclear powerplants already in industrial operation and is also considerably more sophisticated. To mention only one of the most important features, the core is a masterpiece of precision mechanics in which special metal arms remove the fertile material that has become fissile and deposit it in a special cell by remote control and with complete satisfaction of safety requirements. The same mechanical arms remove the superheated uranium and plutonium elements and deposit them in cooling cells. The aggravating problems pertaining to safety stemming from stronger fission radiation, the presence of liquid sodium and the high temperatures involved were resolved with solutions more satisfactory than they ones adopted in nuclear powerplants currently in industrial operation. In fact, in Phenix, it is possible to approach the core without danger to a greater extent than in "old" powerplants and, in addition, it is possible to perform maintenance operations with no need for interrupting the reactor's operation.

In the 6 years that Phenix has been in operation, there have been a number of interruptions for modifications, inspections and repairs (and also for fuel replacement). All this was done to acquire the experience needed for developing Superphenix, but safety requirements were always respected and no accident occurred. Including also scientists, administrators and maintenance employees, the personnel of Phenix amounts to 200 persons, but only a few specialists are needed in the control room for normal operation of the powerplant.

On leaving Phenix, there is the impression that the whole outcry raised, although in various ways, concerning the world's energy prospects is primarily emotional. Anyone who really desires, knows how to obtain energy for the future.

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